19 MAY 1955

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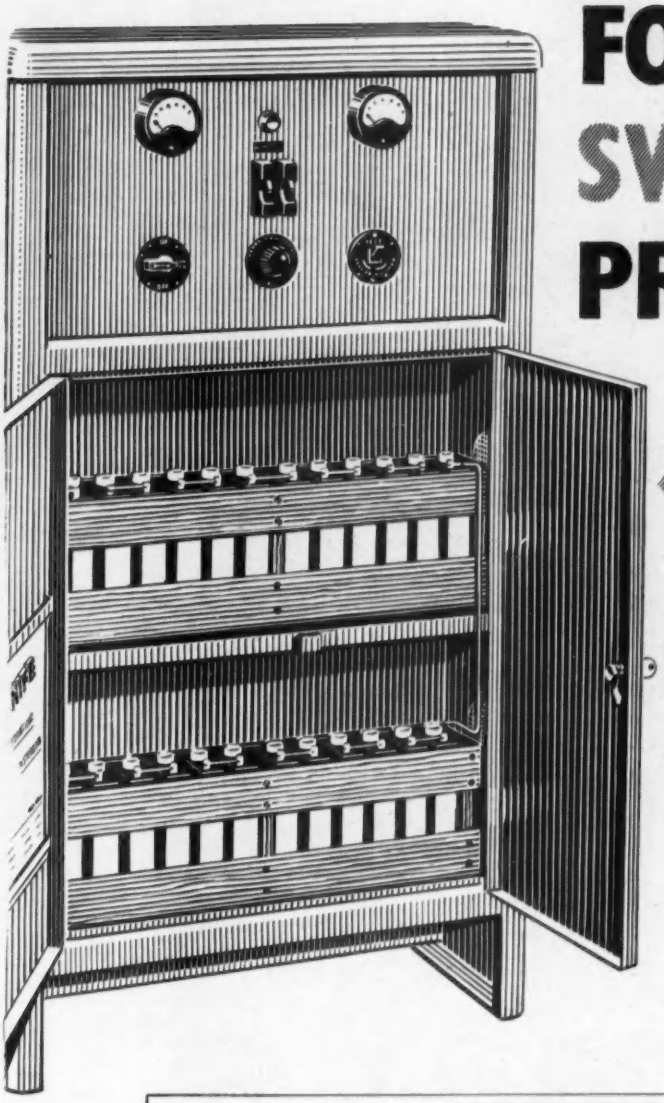

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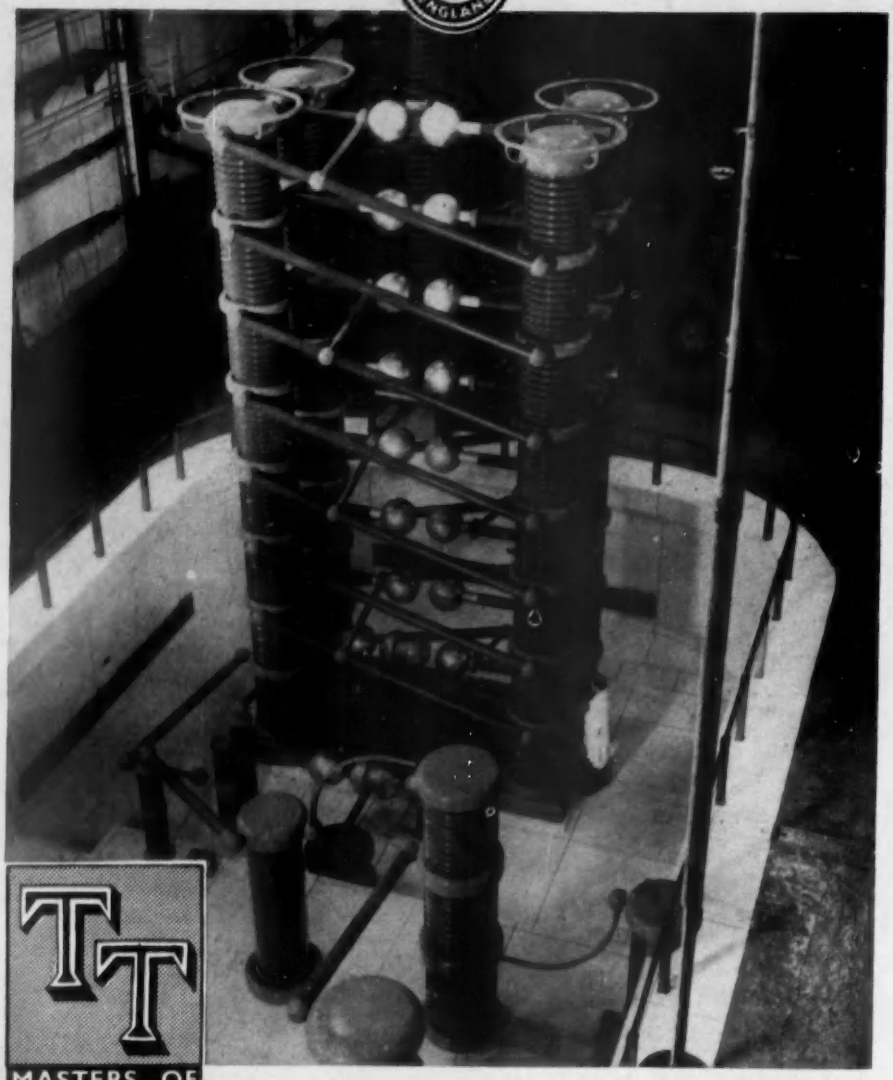

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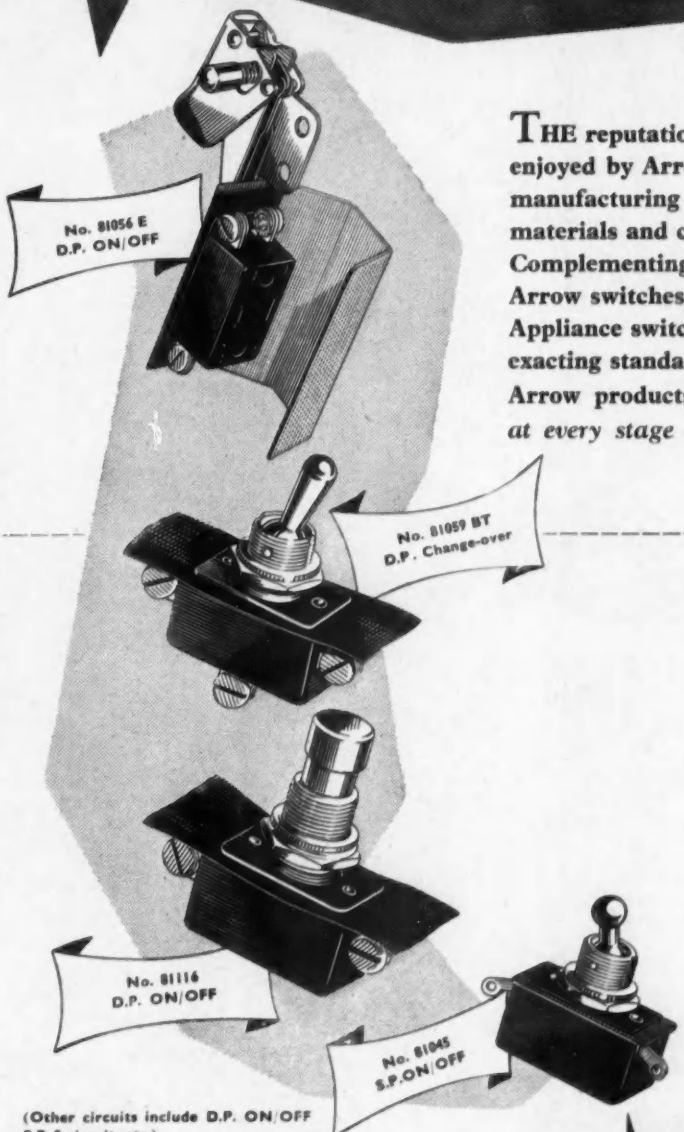


(Other circuits include D.P. ON/OFF S.P. 2-circuit, etc.)

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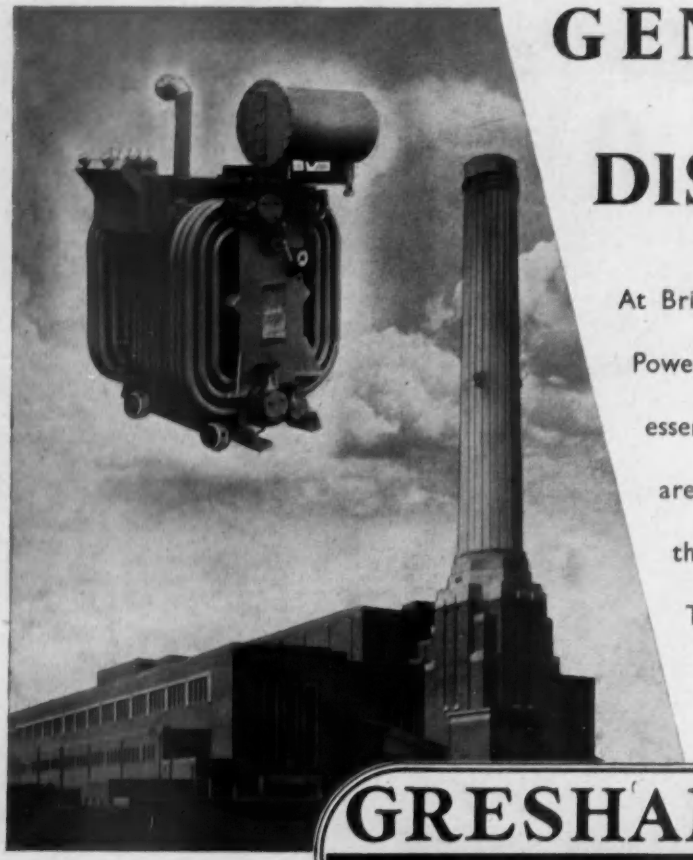

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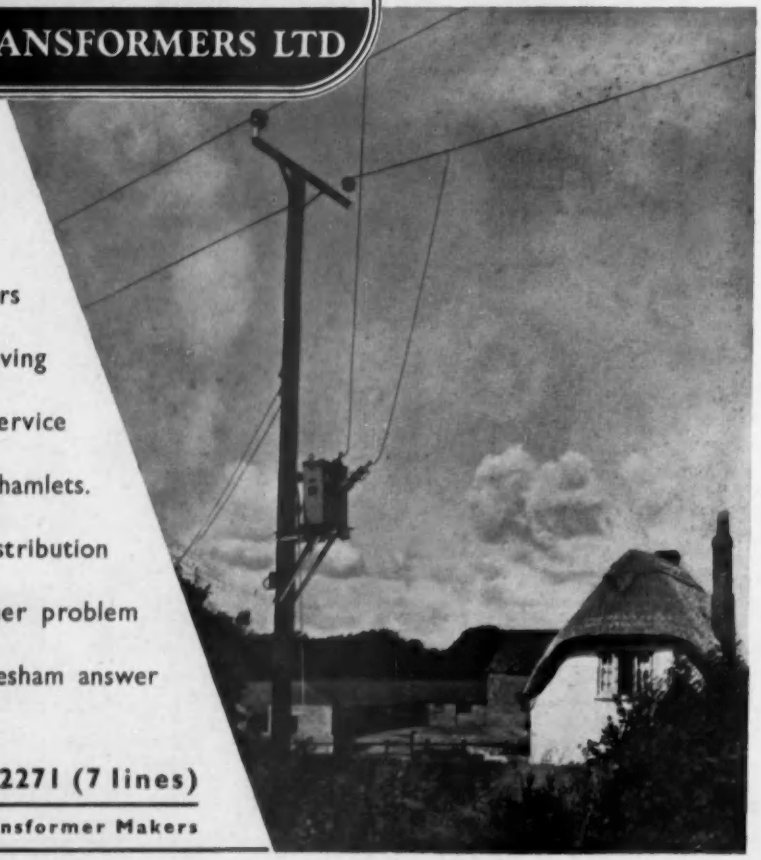

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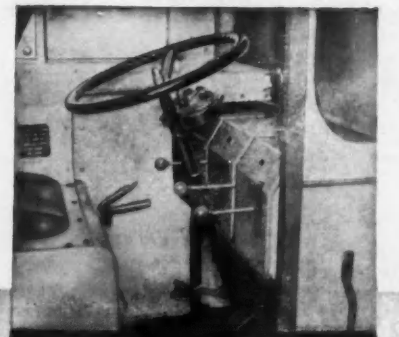

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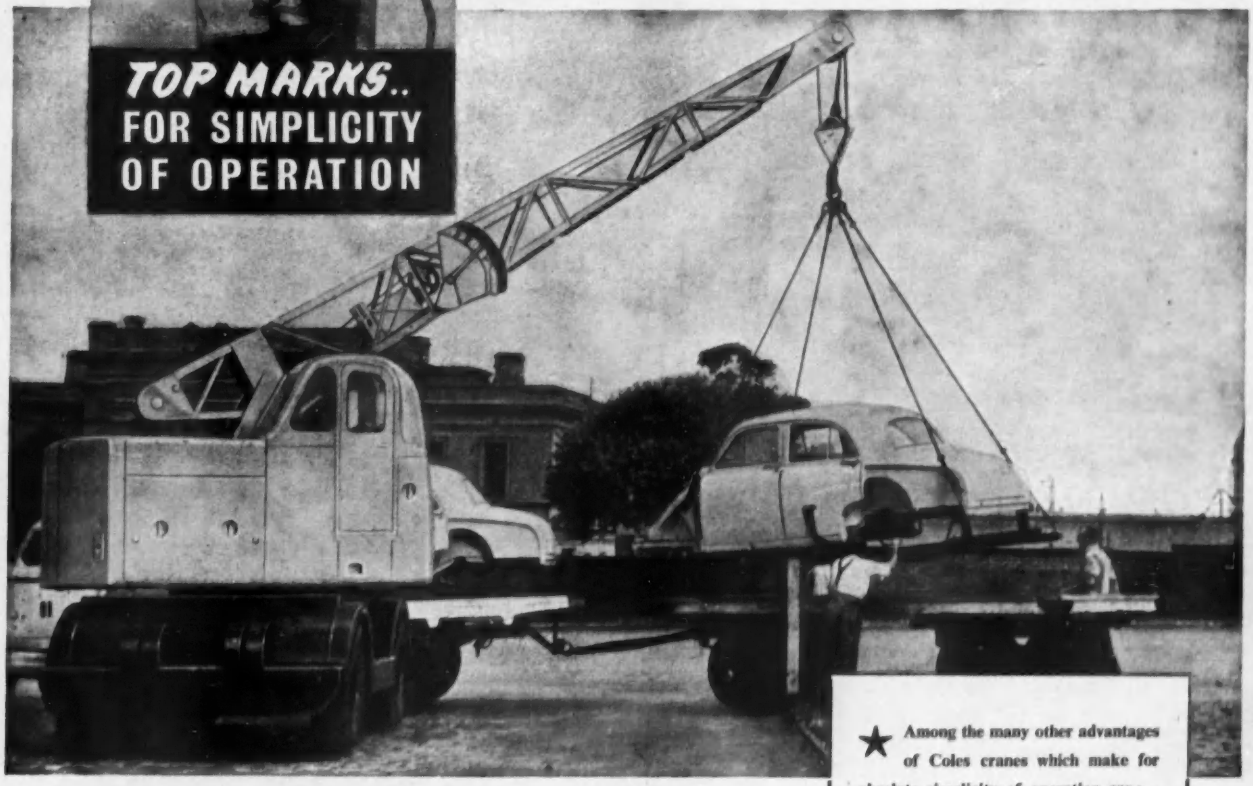

YOU, SIR! Yes, *you* . . . could lay aside this magazine and after just 30 minutes instruction could operate a Coles Crane. Not like an expert, perhaps, but control it none the less, and if that isn't saying how easy it is . . . well!

It's like this, you see; all the controls are grouped together for easy finger-tip operation, there's no clutch or gears to confuse matters and the crane controllers have a spring return which halts motion instantly you release pressure. Then there is the fully automatic reversing steering mechanism, which is a technical way of saying that no matter what the relative position of the crane cab and chassis, the travel steering is 'natural'. And if you should feel that a big 20-ton lorry-mounted Coles is a bit beyond your capacity, you'd be wrong again, because they all have power-assisted steering which means that even on rough ground you can steer the vehicle with one finger. It all sounds easy . . . like to try it?*

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★ Among the many other advantages of Coles cranes which make for absolute simplicity of operation are:—

A full-vision cab, giving perfect visibility. Several safety devices which are built in as integral parts of the system. The ability to operate each motion individually or in combination and to slew full circle in either direction without limit. Safe, controlled lowering of loads under power, NOT just against the brake. The electric transmission system, which makes possible infinitely variable speeds with positive control and saves power by obviating gear trains.

These are but a few of the reasons why there are more Coles mobile cranes in service today than any other type. For the Coles is the crane with clear advantages from everyone's point of view, be he owner, operator, or maintenance man. It's worth thinking about before you buy a mobile crane.

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COLES

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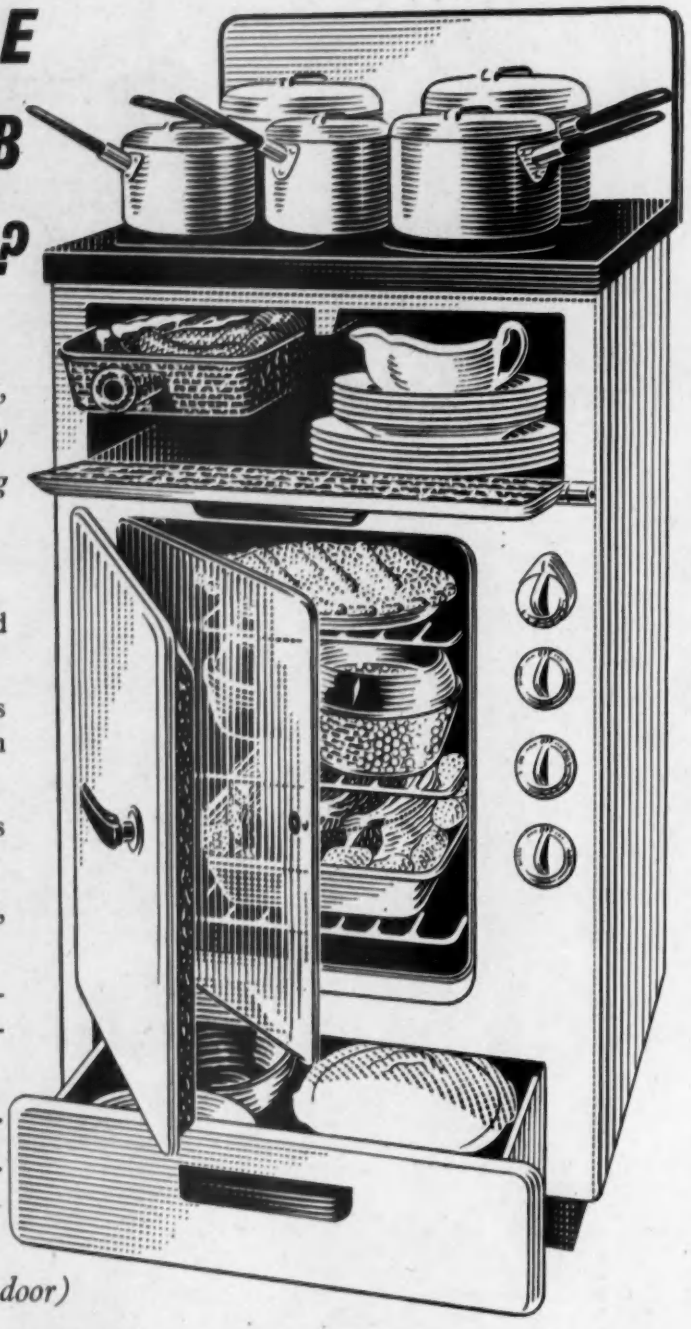

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* It is widely advertised, nationally and locally.
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* The unique system of oven heating, with automatic oven control.
* The really large oven, large hot-cupboard and utensil drawer (24/- extra).
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* It's extraordinarily easy to keep clean.

*Low price* — **only £32·5·0**
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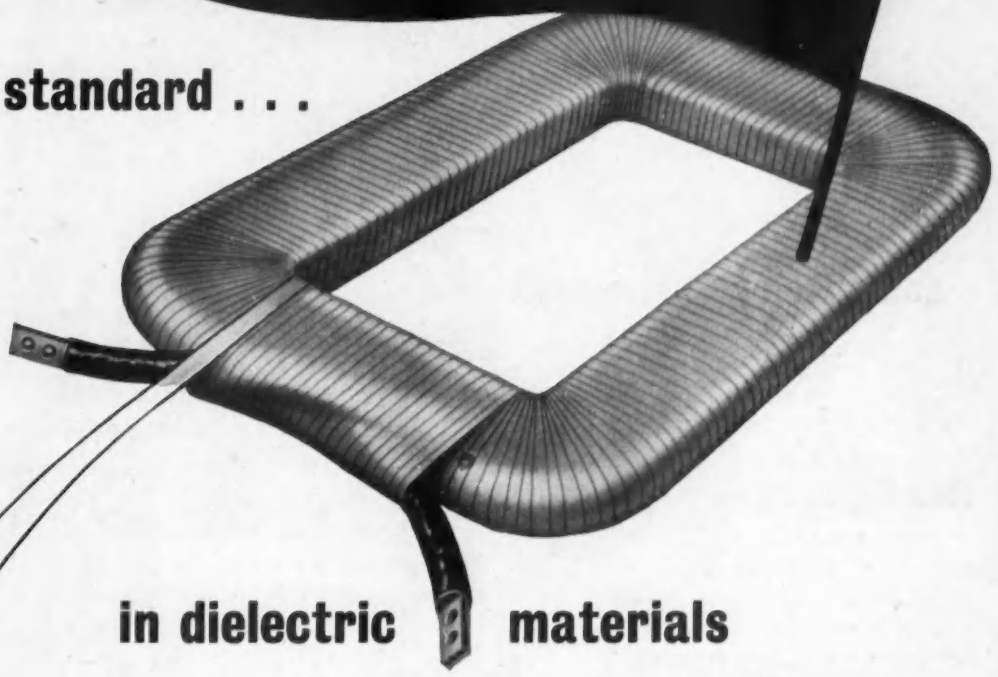

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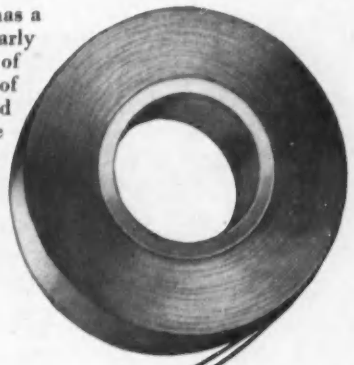

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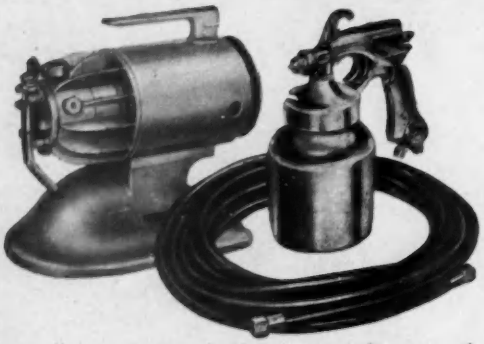

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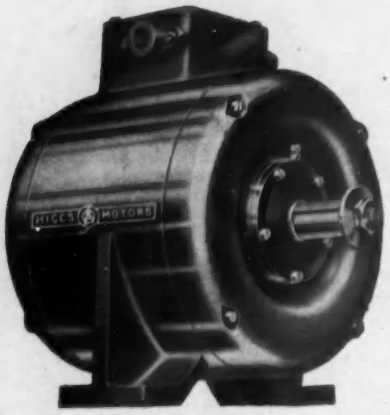

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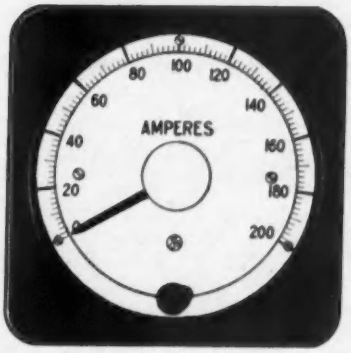

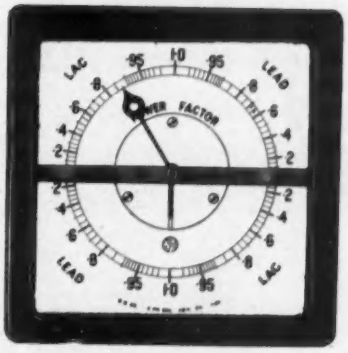


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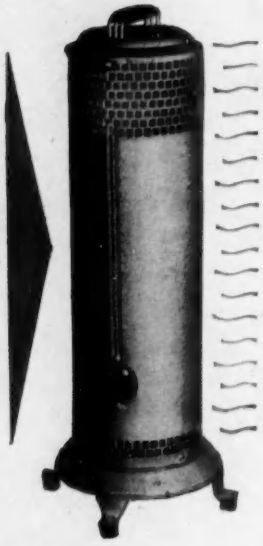

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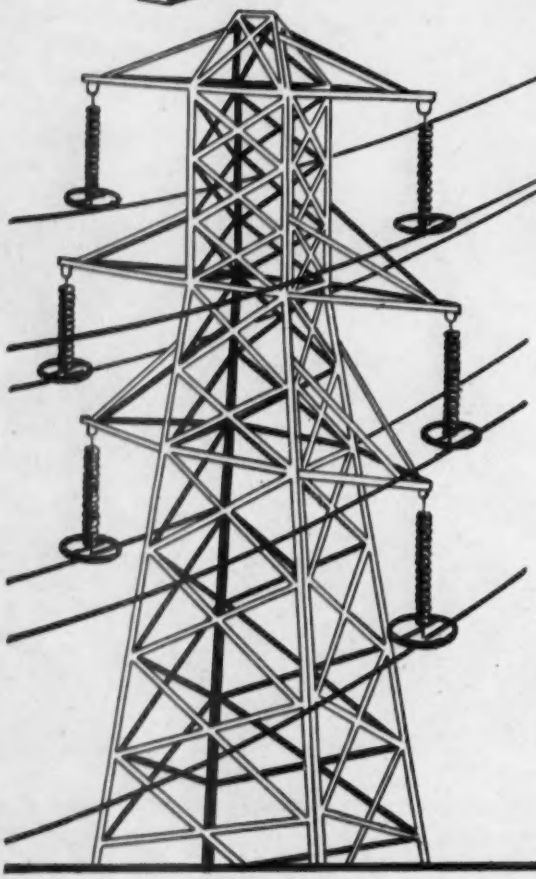

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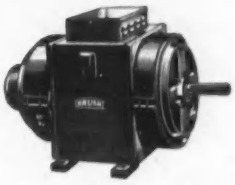

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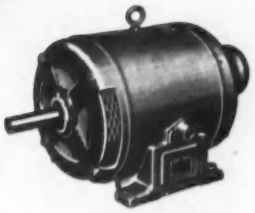

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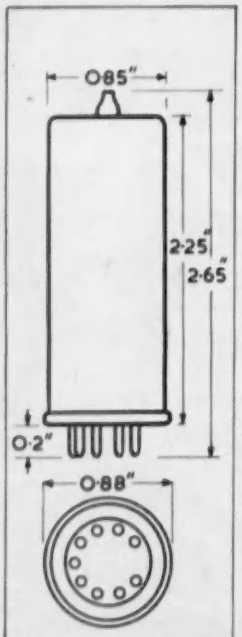


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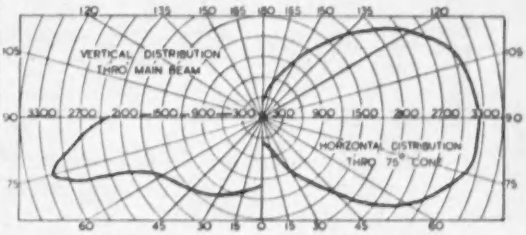


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| 1,000 | .158 | .224 | .274 | .316 | .388 |
| 1,500 | .129 | .183 | .224 | .258 | .316 |
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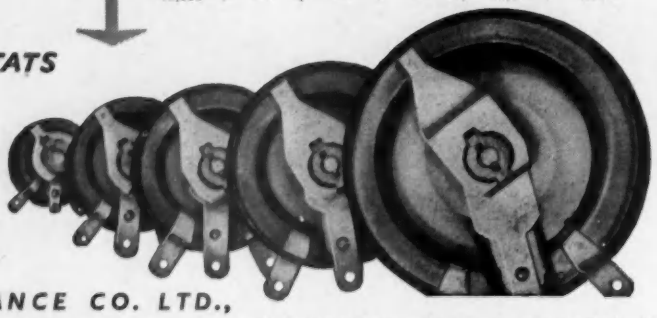

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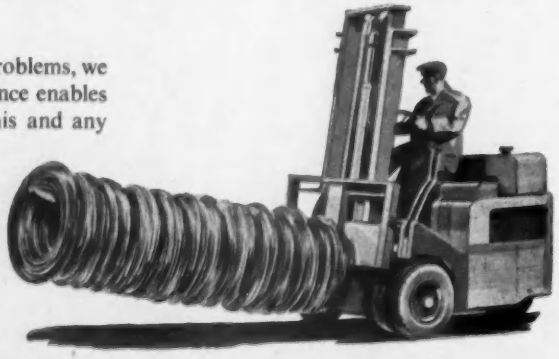

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Rounded edges of nut permit easy insertion. Spring (your third hand) holds nut snugly in place for bolting.
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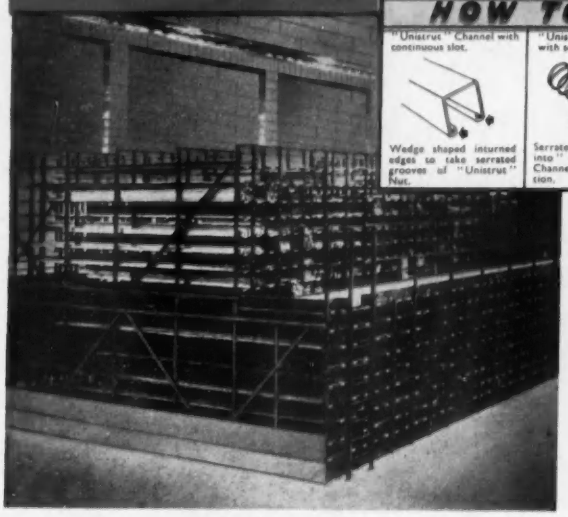

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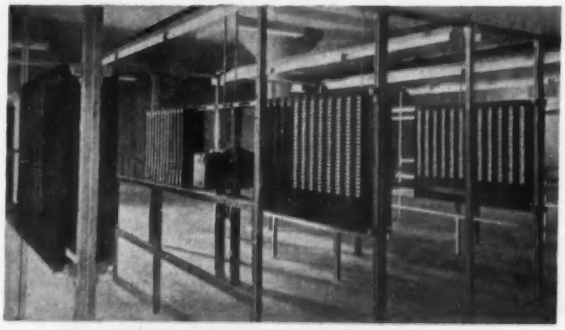

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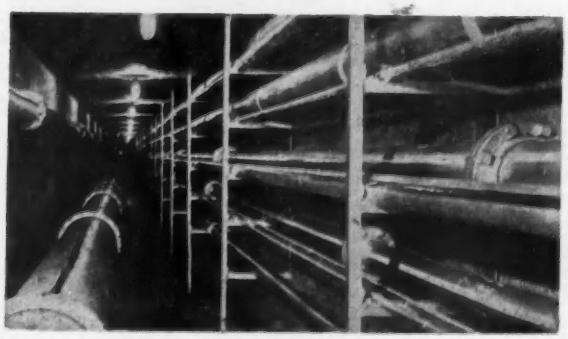

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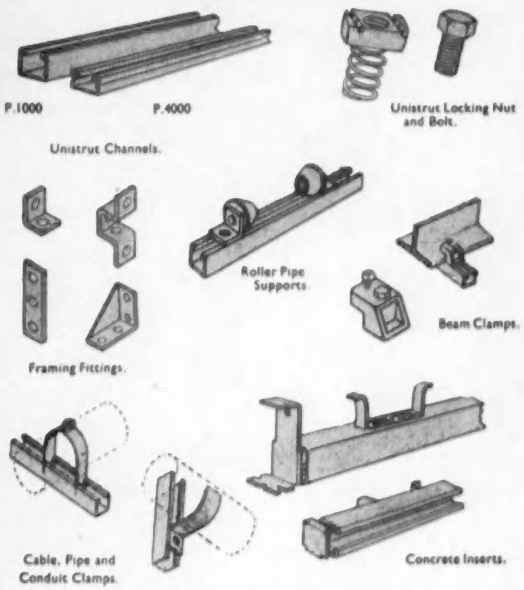


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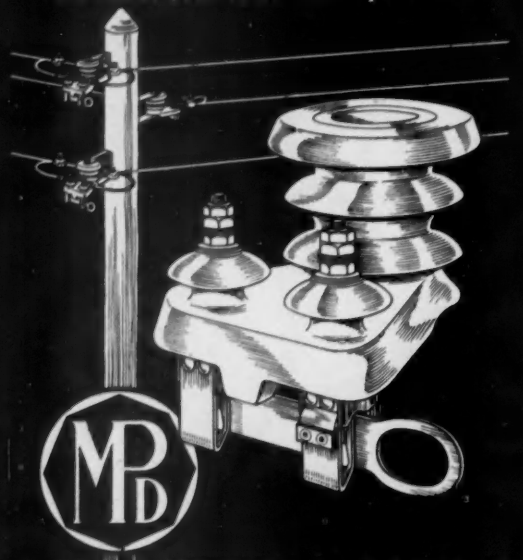

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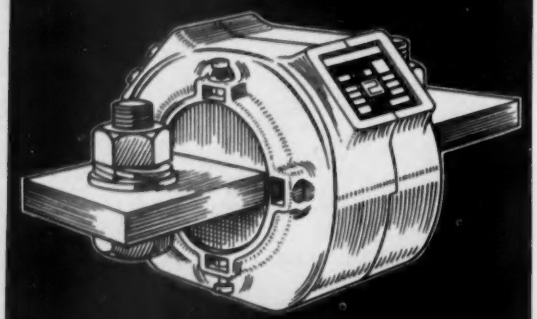

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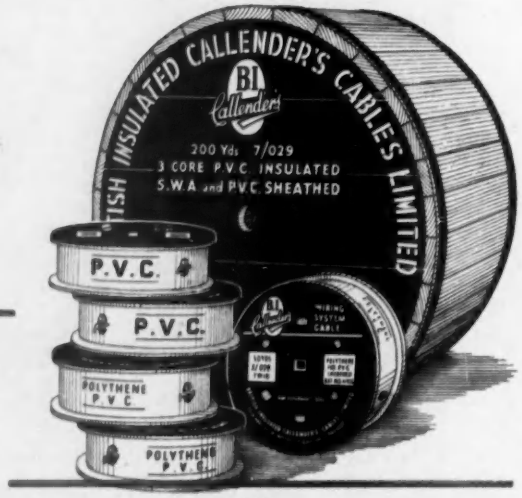


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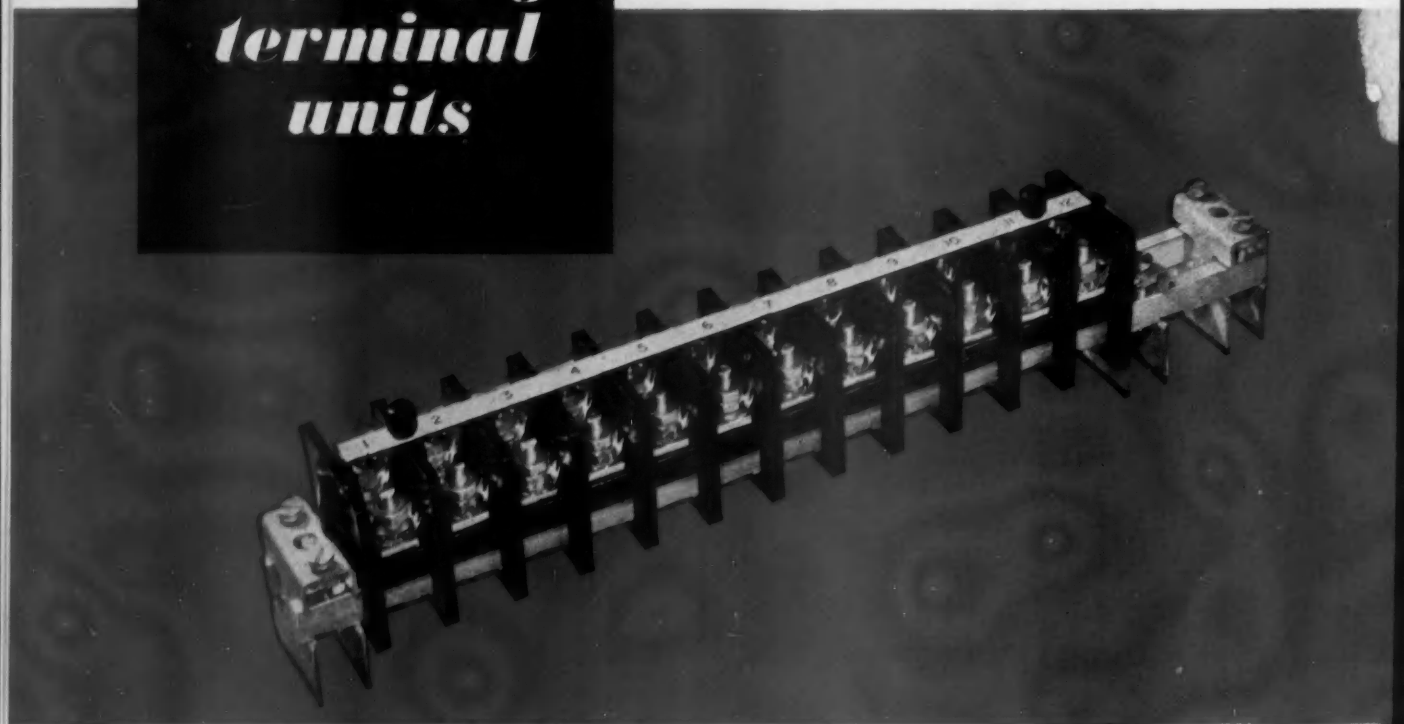
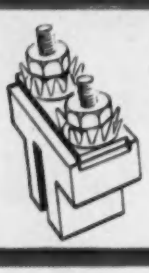
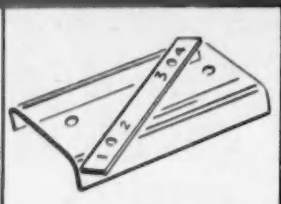
# ASTRAL *multiway terminal units*







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***DESIGN*** Any number of terminal ways, built from eight basic types of interlocking components. No live metal underneath, and room to pass cables under. Framework earths. Optional, bridging links, two, three or more ways. Supplied assembled and co mplete, or in parts to order.

***MATERIALS*** Terminal pillars on solid plates, all nickelled brass, each pair on heavy moulded black phenolic segments, with separate barriers, all locking into position. Cadmium plated steel support bars, brackets and screws. Optional, nickelled copper bridging links.

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***TERMINALS*** Rating 60A. 660V. Each separate segment has two No. 0 B.A. Pillars, with lock nuts and claw terminals, or cable sockets if specified. Each interlocking segment can be separately removed, for easy connecting.

***SHIELD & LABEL*** Optional. Both separately detachable, secured by insulated screwed knobs. Rigid transparent P.V.C. shield. Ivorine label supplied blank, or numbered lettered per terminal way to order.

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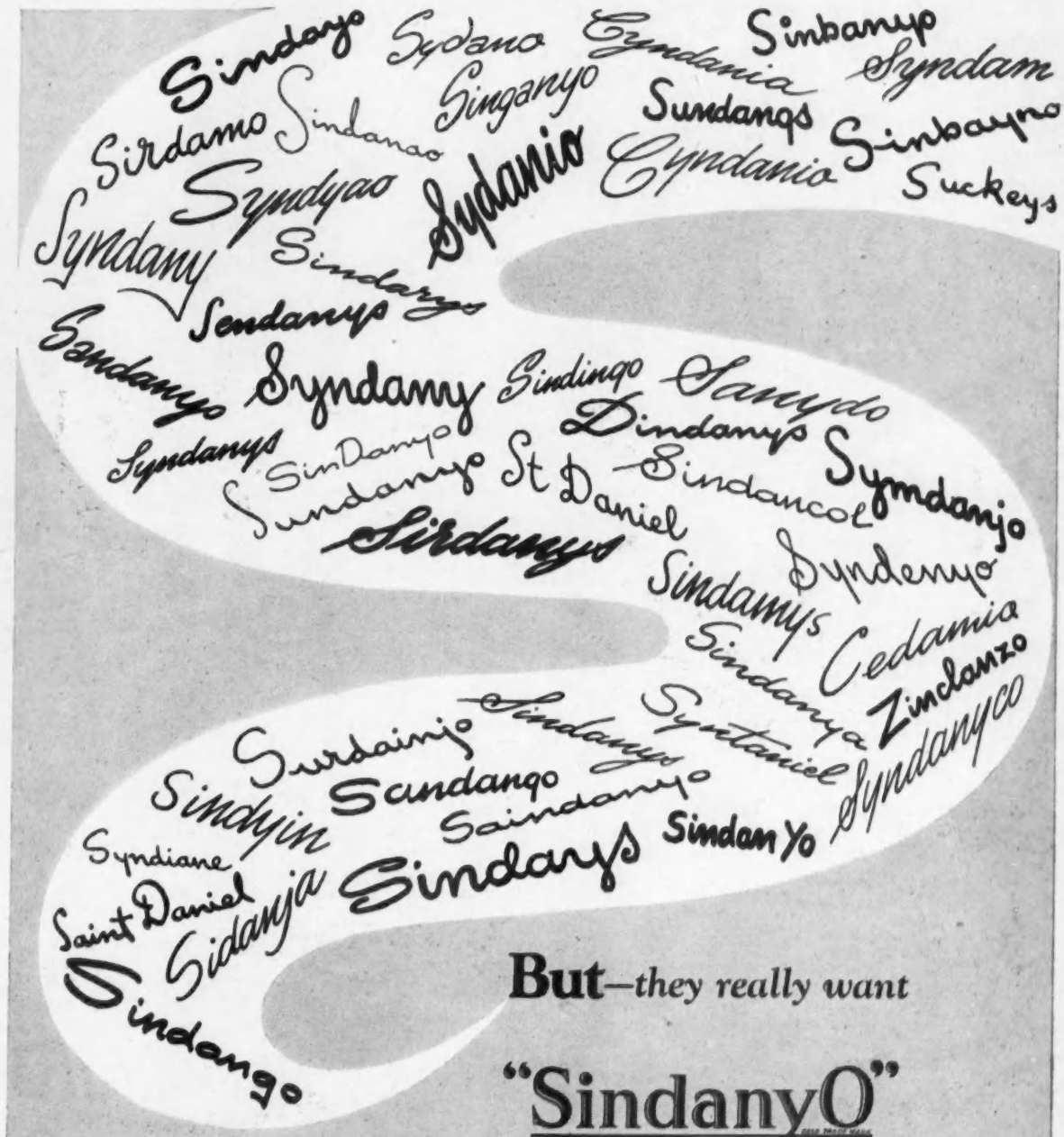


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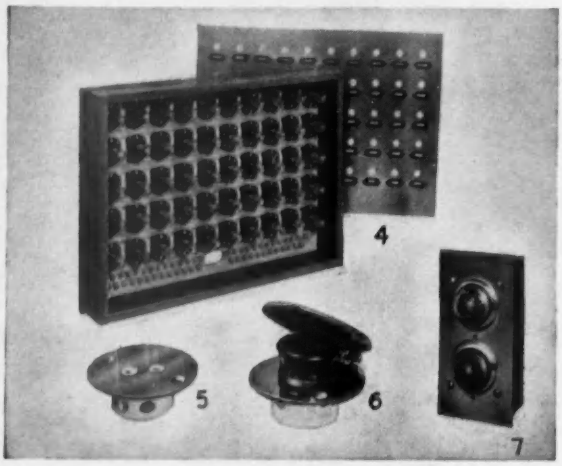


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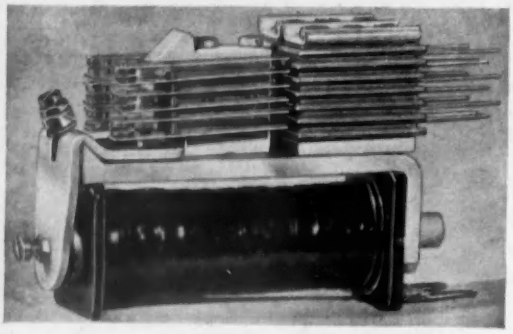

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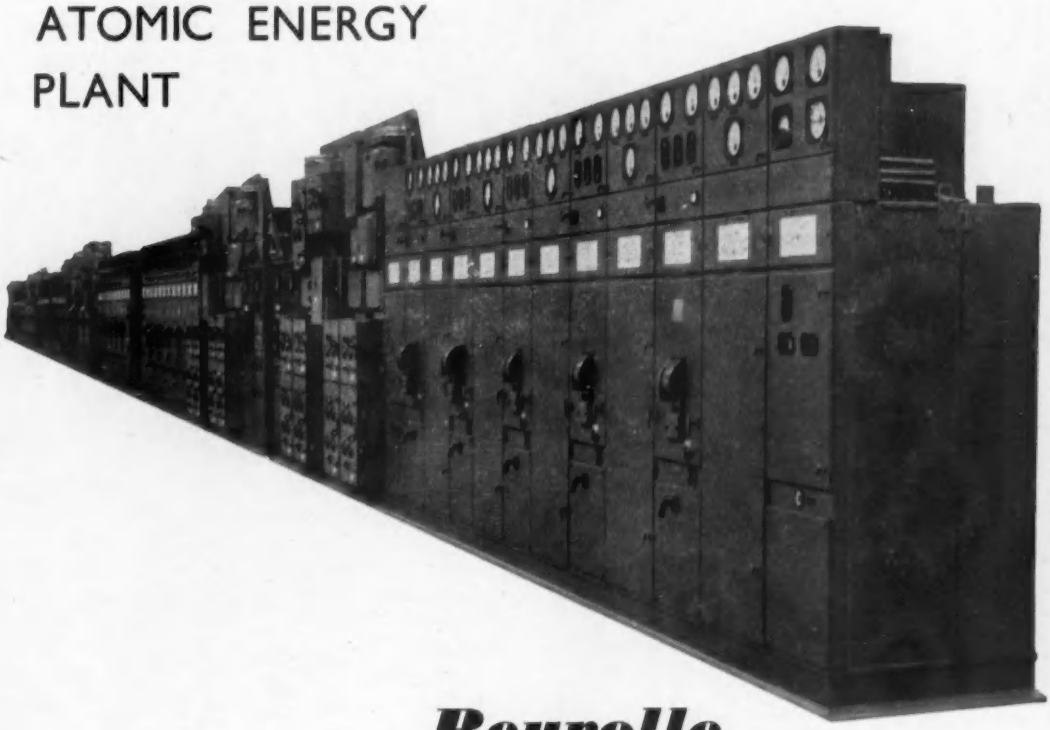

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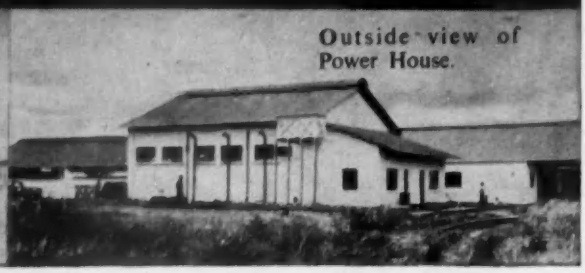
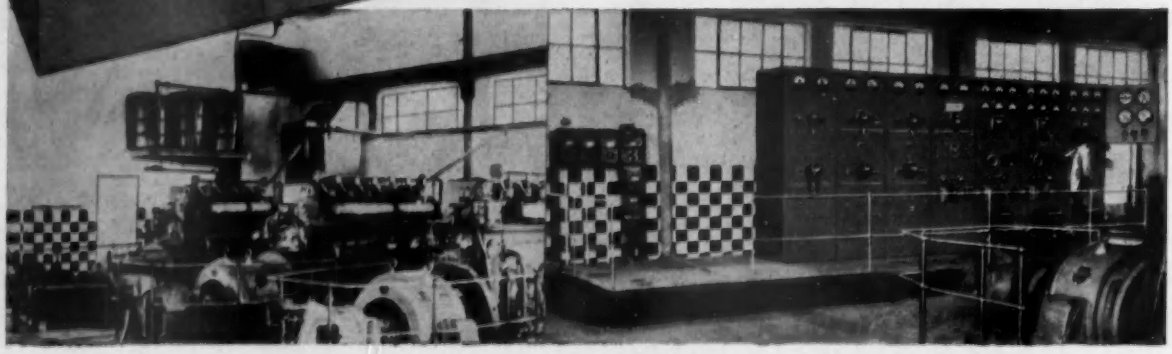
General view of new Kingolwira Sisal Factory from main road.



Outside view of Power House.

Switchboard controls three diesel Alternator sets and outgoing feeders with duplicate bus bars so that the output of any arrangement of Alternators can be selected.



Engines and Alternators.

Main Switchboard in Power Station.

The Factory where the above installation is situated belongs to The Central Line Sisal Estates Ltd. and is situated near Morogoro, Tanganyika, and replaces two old factories. The numerous small engines in the existing Factories were replaced by the new diesel electric station which now also supplies the power for 3 kV transmission line to supply power for the pumps at the river.

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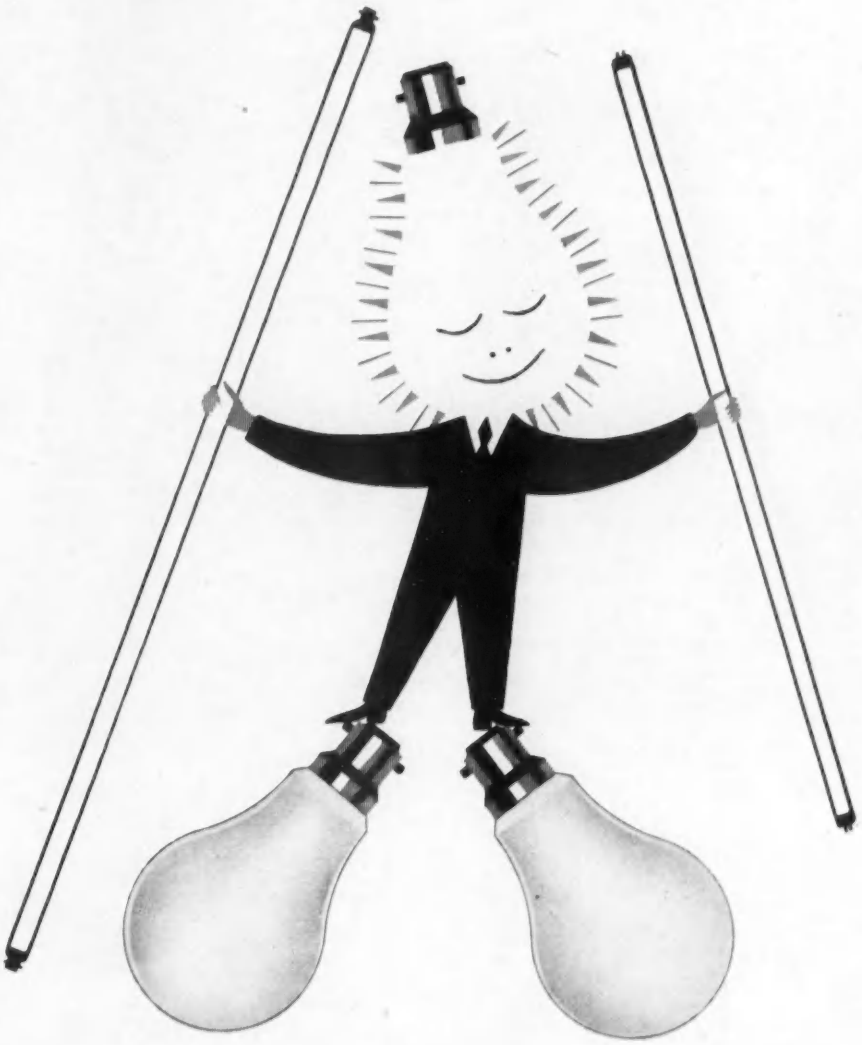

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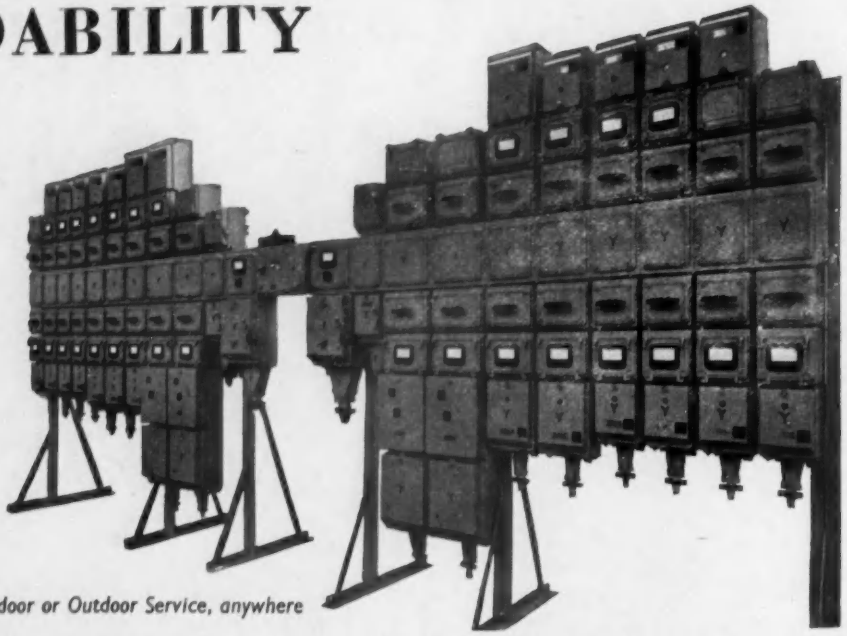

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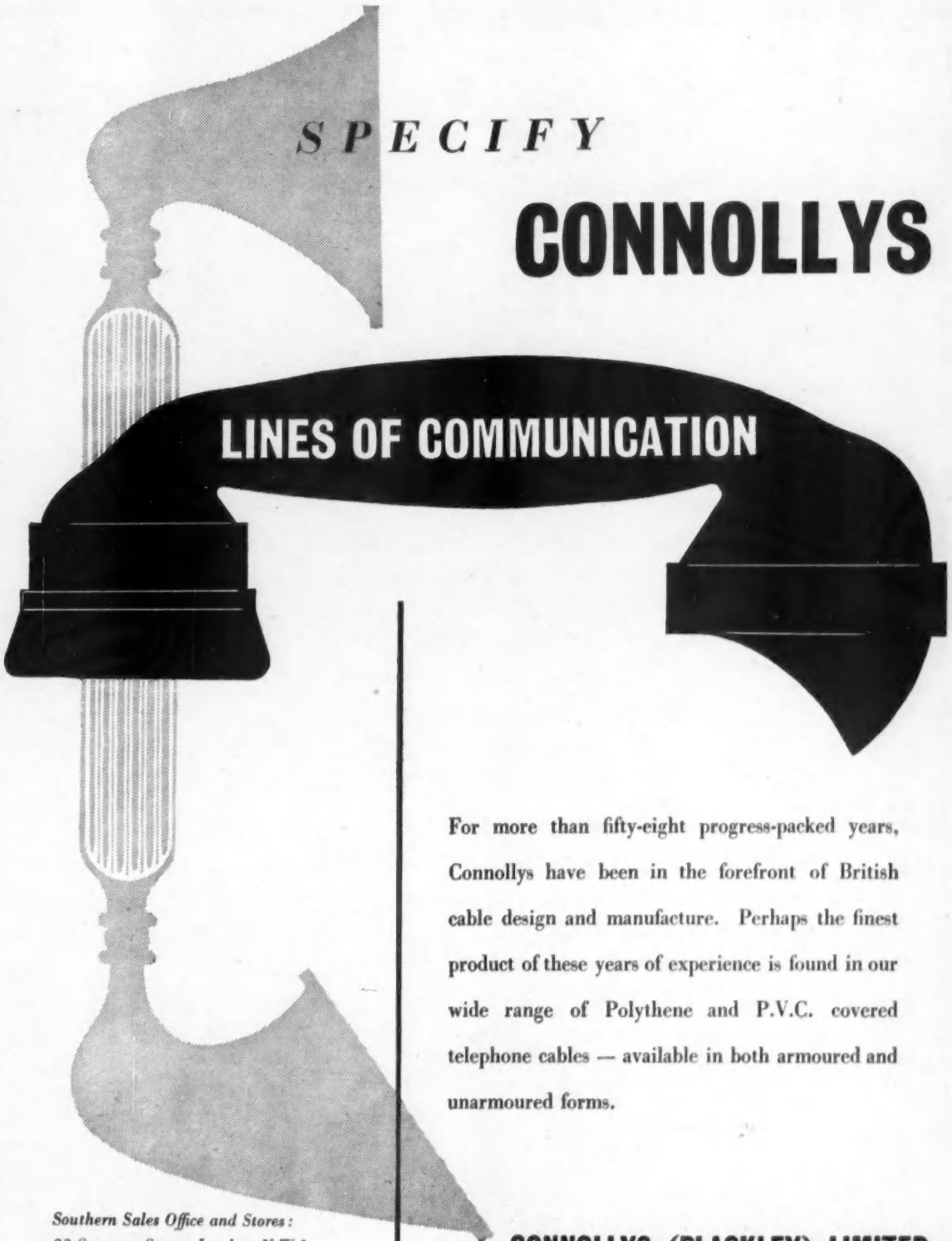

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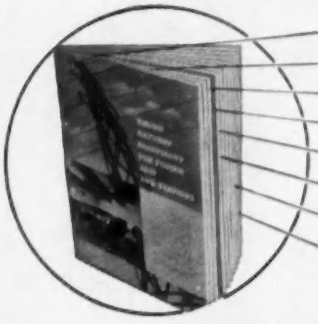

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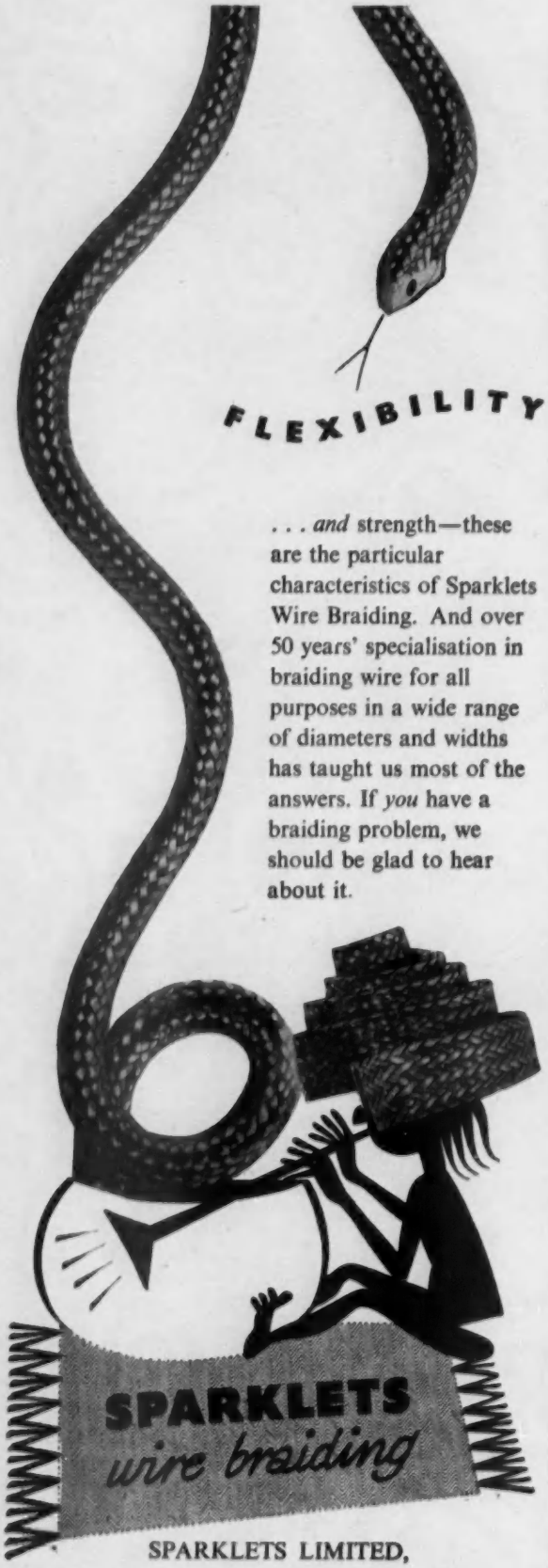


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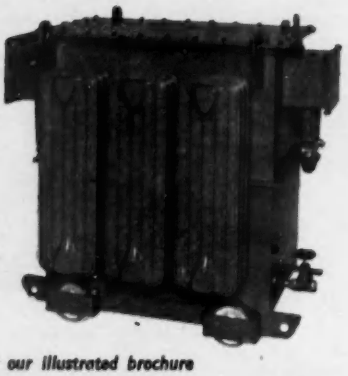

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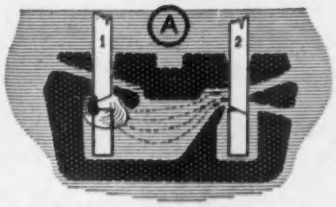
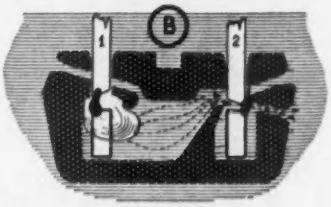
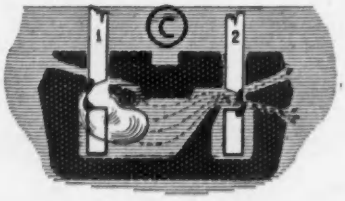


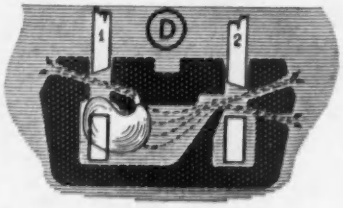

No. 1 electrode leads by ¼ cycle. Pressure trapped except for constricted relief at No. 2 in advance of arc.



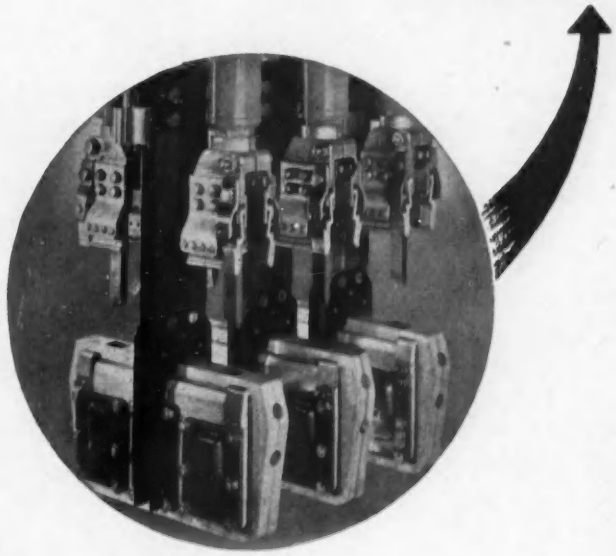

No. 2 electrode breaks contact. Arcing restricted and displaced by pressure.




Arc severed at current zero by high pressure clean oil




Arc-trap scoured by exhausting pressure and rapidly refilled with clean oil.



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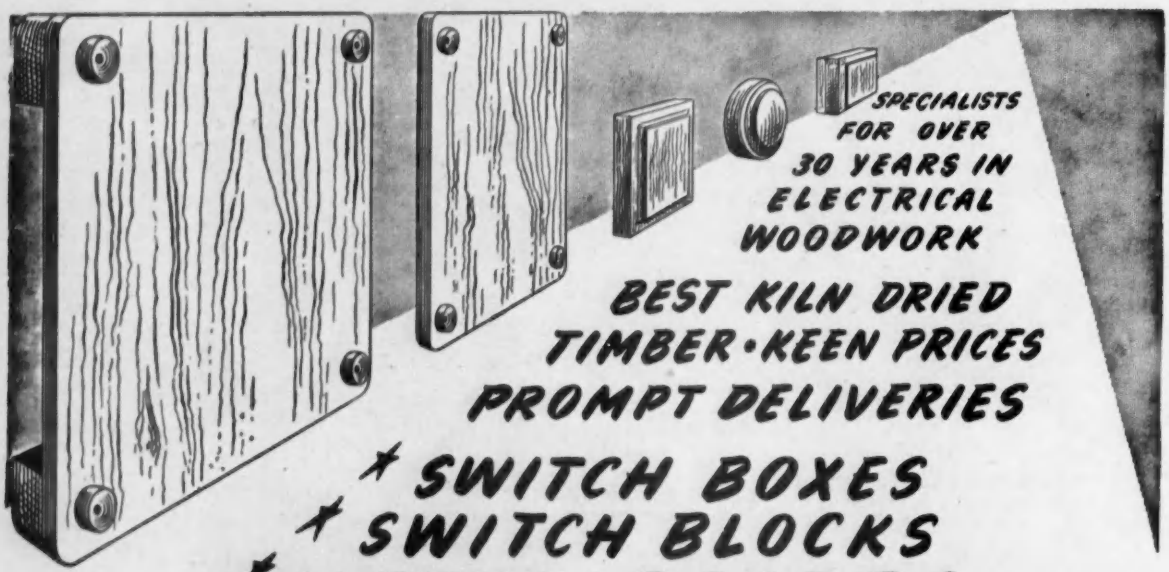

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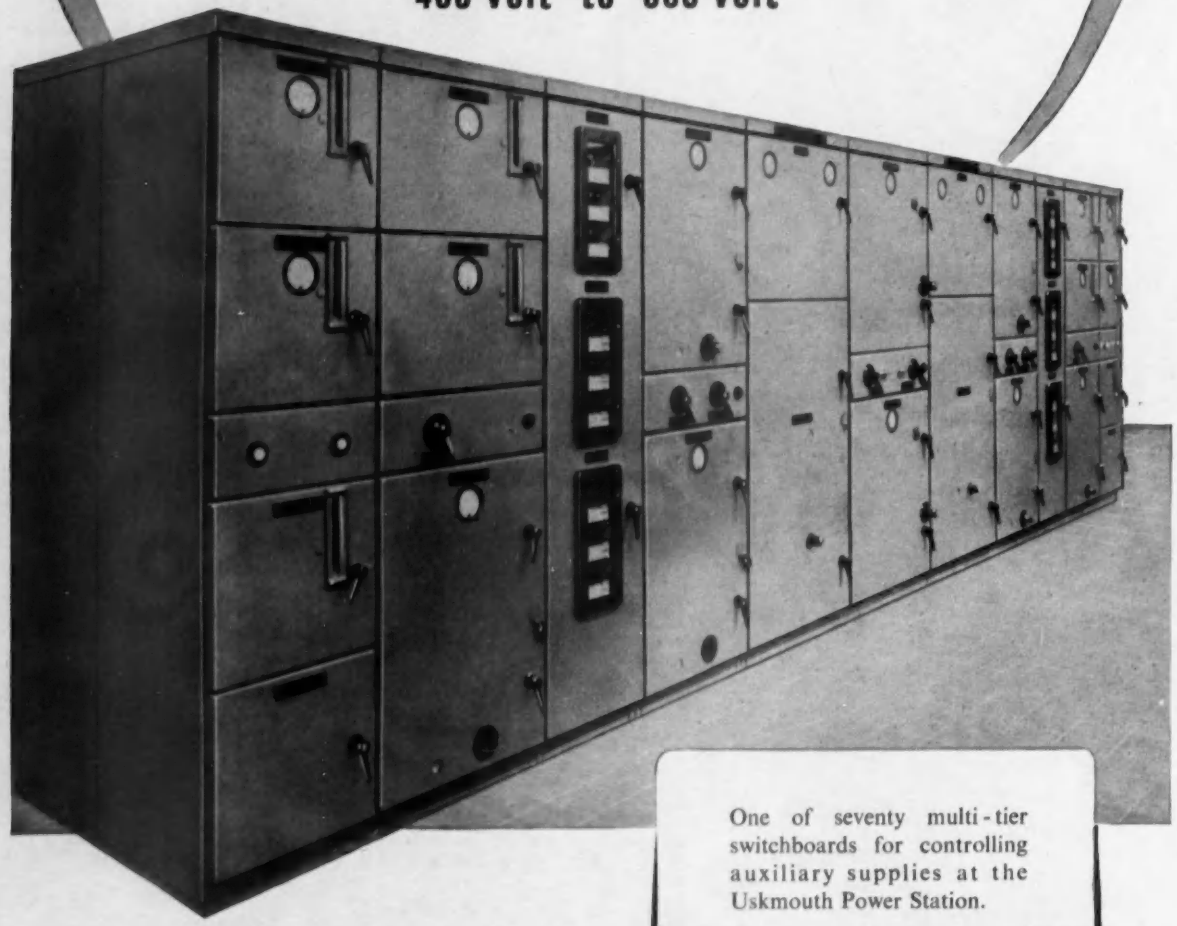

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# ELECTRICAL TIMES

ESTABLISHED 1891

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## EFFICIENCY MOVES UP

Thermal efficiencies of American power stations have been well ahead of equivalent British efficiencies for many years now, though before the war there was little in it. The magnitude of the difference in recent figures—28·7% against 23·4% for average values of all stations—has understandably led correspondents to enquire if a different basis of calculation is used across the Atlantic. It is not. Wartime difficulties, projected into the present, almost entirely account for the gap. This view of the present position was forcibly stated by Sir John Hacking at the E.D.A. annual luncheon last week in a speech which painted a picture of future development in this country far in advance of anything that has previously been foreshadowed. The 26% average efficiency for 1960 which has been promised in official statements should, he suggested, be substantially exceeded. Moreover, new plant now under construction may even attain an efficiency equal to the best in the U.S.A., at present around 38%. Such progress is welcome indeed, and must make a great contribution to improvement of the nation's fuel position. To attain its greatest effectiveness on the country's economy as a whole, however, improvement in efficiency needs to be coupled with a sharp improvement in load factor. Sir John was emphatic that only thus can the benefits of high efficiency plant be spread most widely, and the high fixed charges which are the inevitable concomitant of new plant, be to some extent offset. Although the supply industry can do much to encourage the consumer to diversify his load, in the last analysis the power to improve load factor lies with industrial management and men. To that extent they exercise their own control over fuel costs, about which they complain so readily.

## NUCLEAR SALESMANSHIP

Although the Conference on Nuclear Energy to be held in Geneva in August will embrace a bewildering complexity of scientific topics, its general purpose is clear enough. In the words of the United Nations General Assembly it is "to promote energetically the use of atomic energy to the end that it will serve only the peaceful pursuits of mankind and amelioriate their living conditions." To achieve this is a task for engineers and manufacturers, and this consideration makes particularly appropriate one of the less publicised features of the plan for Geneva. This is the staging, in conjunction with the conference, of an industrial exhibition, further details of which are given on another page of this issue. British firms are planning to take a leading part both

in the instrument field and in the heavy engineering techniques of reactor development. Thus the Geneva Conference promises to be the first public showing of the British nuclear energy industry. There has been substantial growth in recent months, signalled by the formation of several groups facilitating the co-operation of companies with experience in the many different engineering activities which are needed for the harnessing of nuclear energy. Since such resources are available only in the most highly industrialised countries, while the benefits of nuclear power generation are applicable everywhere, it is apparent that Geneva is equally the first step in a great export venture. This at once signals the importance of the exhibition to Britain; in August nuclear salesmanship must back up the achievements of British engineers and scientists.

## WIRING TO SPECIFICATION

Electrical contractors too often have to tender for a small house-wiring job on the basis of a loose specification or none at all. Often there is little more to go on in estimating a price than the number of lighting points and socket-outlets required in each room. Simple standard specifications that tie down the tender to good modern practice have now been prepared by the Electrical Contractors' Association, a service to the installation industry which should be welcomed by all concerned, except the perpetrator of shoddy work at a cut price. The architect especially should be glad of a form of words which, while in no way restricting him either in choice of wiring system or in positioning of lights or socket-outlets, does relieve him of the worry of guiding his client on the details of a specialist branch of building construction, one in which he has usually received only a superficial training. For the contractor the advantages of such specification are obvious: they are all that come with tendering to a clear specification with an absence of easy loopholes for the less conscientious competitor. Undoubtedly, the E.C.A. has done a good job in these new publications. It now remains for the architectural profession to accept the encouragement which the specifications offer for improved standards of electric installation.

## ELECTRICITY AND MEDICAL RESEARCH

The precision and accuracy of electrical methods of control and instrumentation are finding an ever-increasing field of application in medical research. Within the past few years, the electrical, and particularly the electronic, engineer has become most closely involved in this branch of study. A recent example of this co-operation is the new man-carrying centrifuge now operating at the Institute of Aviation Medicine at Farnborough. Here the power engineer was called upon to provide a drive for a rotating mass consisting of a 4-ton horizontal arm, some sixty feet in length, together with a 12-ton flywheel. The drive itself had to be capable of the finest precision control and absolutely reliable. The electronics engineer on the other hand had to provide a system whereby voltages of the order of microvolts could be transmitted over cables and through sliprings for a distance of some 100 feet, from the subject to the high sensitivity amplifiers located in the recording room. That these problems were satisfactorily solved well indicates the capability of engineers to fulfil the demands made upon them. From a medical aspect the data obtained from this plant will be invaluable in assessing the capability of men and also of equipment for standing up to the abnormal accelerations imposed by the manœuvring of high-speed aircraft.

## N.S.W. BANKS ON STEAM

So much accent has been placed on the Snowy river and its associated schemes that one is apt to think of electricity expansion in New South Wales and Victoria in terms of hydro-electric development. With an average load growth of ten per cent per annum and a memory of acute plant shortages in the past. New South Wales is, however, looking to thermal stations for supplying its base load. Mr Condé, chairman of the N.S.W. Electricity Commission, recently stated that by 1962 they are planning an additional 920 MW of steam generating plant. As befits large base load stations, high performance sets will be required with ratings up to 100 MW and steam conditions of 1,500 lb/sq in. and 1,050° F. By 1964 a further 600 MW will be needed. Attention is being given to the siting of new stations near coal supplies on which the electrical economy of the State will continue to be based, while to handle the increased power, the transmission system is being heavily reinforced. In particular, a 330 kV line is being run from the Tumut development scheme to the outskirts of Sydney, and the order for the first 70 mile section has already been placed. Such is the electrical prospect before New South Wales.

## STANDARDS IN A NUTSHELL

British standard specifications are necessarily tightly worded documents, drawn up to avoid the risk of ambiguity. This quality avoids many possible misunderstandings but it does have undoubted disadvantages at the point of application. Essential information is liable to be hidden amongst qualifying verbiage, and routine test requirements to be overshadowed by type test demands, appropriate only at the design and prototype stages. Again, a whole range of similar products may be covered in one standard, whereas interest in the shops may be on one product only at a particular time. One way commonly adopted of overcoming such difficulties is to extract the essential information for the job in hand into data sheet form. Now the B.S.I. is considering extending its own activities in this direction. At present B.S.I. data sheets in the main standardisation series are confined to such tabular standards as those on limits and fits, though certain aircraft standards are also produced in this form. The proposal for an extension of this service received a ready welcome from a recent meeting of engineers specialising in the application of standards in individual firms, which B.S.I. organised, and it is likely to be well received in an even wider field. In particular, such an extension of standard presentation in the proverbial nutshell should have the desirable effect of encouraging the use of British Standards amongst the smaller firms, with special advantage where these are involved in subcontracting work.

# The Measurement of High Voltages

## PART 2. Problems Asssociated with Measurement of Impulse Voltage

By P. R. HOWARD* B.Sc.(Eng.) A.M.I.E.E.

THE most severe test of electric strength imposed on equipment is provided by the transient voltages which appear on transmission systems through lightning and circuit faults. The main cause of damage arises from lightning either in the form of direct strokes or from electrostatic induction. Most of the high-voltage research over the last twenty-five years has been directed to studying the behaviour of dielectrics and equipment under voltages similar in form to those resulting from lightning. The impulse generator which is used for simulating these voltages is based on the original Marx circuit; in this circuit a number of capacitors are charged up to a high-voltage (usually between 100 kV and 400 kV) in parallel and then discharged in series by the breakdown of sphere-gaps.

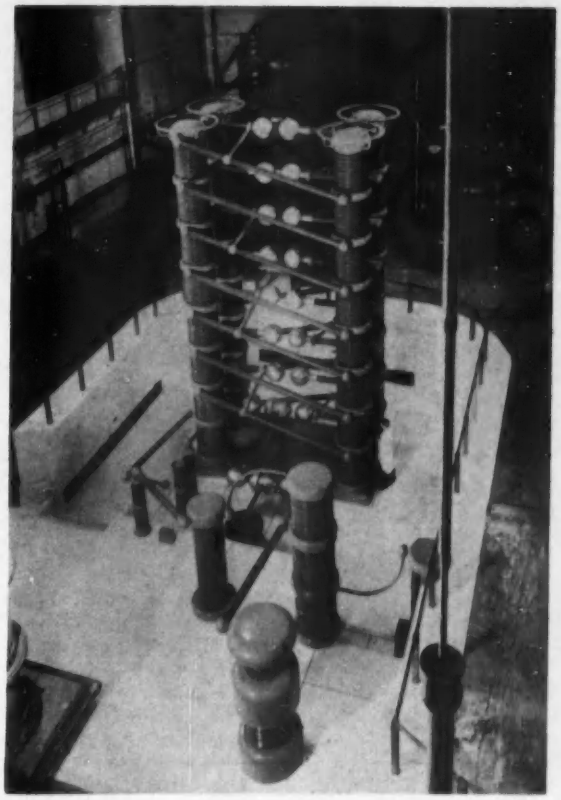
The normal form of impulse voltage, which corresponds to travelling waves encountered on transmission lines, is one having a rapid rise in voltage to a peak value and then a decay at a slower rate; mathematically the waveshape can be expressed in the form:

$$V = A\,(\varepsilon^{-\alpha t} - \varepsilon^{-\beta t})$$

The shapes of the impulse waves used for testing have been standardised in various countries. In Britain, B.S.923: 1940 gives the standard wave as a 1/50 microsecond one; the numbers indicate, respectively, the time during which the voltage is rising to its peak value and the time during which it subsequently falls to one-half of the peak value. A typical waveshape is given in Fig. 1 together with the prescribed methods of measurement of wave-front and wave-tail. For impulses of shorter duration the 1/5 microsecond wave is a standard.

As in the cases of direct and alternating voltages, the measurement of high transient voltages requires either a divider, so that an appropriate fraction of the high-voltage can be recorded, or an instrument capable of measuring the total voltage, such as a sphere-gap. With impulse voltages accurate records of the wave-form as well as the peak value are required, and the normal recording instrument is a cathode ray oscillograph connected to the circuit through a delay cable and a potential divider. Circuits have been described for measuring the peak value of the impulse wave using a divider and either a ballistic galvanometer or an electrostatic voltmeter; these arrangements, and the use of sphere gaps are discussed later.

The generalised circuit arrangement for voltage measurements is given in Fig. 2. The divider can be constructed from resistors, capacitors or combinations of both, and the essential requirement is that the waveshape of rapidly changing phenomena should be faithfully reproduced at the oscillograph with a reduction ratio which can be accurately determined. The most common forms of divider make use of either resistors or capacitors; parallel and series mixed dividers (resistor and capacitor combinations) have specialised applications. The chief source of error for all forms of divider arises from the capacitance to earth of the high-voltage arm; under certain circumstances inductance is of importance, particularly for impulses lasting for about one microsecond.



*An impulse generator with 3·2 MV open-circuit voltage and 77 kW-sec stored energy installed at the National Physical Laboratory, Teddington (Crown Copyright)*

### Resistor Divider

The effect on the response of a divider of residual inductance and capacitance, and earth capacitance has been comprehensively treated by the author elsewhere; in the following analysis only earth capacitance is considered. If it is assumed that the earth-capacitance ($C_e$) is uniformly distributed along the length of the resistor (ohmic value R), the divider may be regarded as a transmission line of finite length, earthed at one end, possessing series resistance and shunt capacitance.

With a transient voltage wave of the form $A\,(\varepsilon^{-\alpha t} - \varepsilon^{-\beta t})$, where A is a constant such that the peak amplitude of the wave is unity, the fraction of voltage (e) appearing across the low-voltage arm of the divider takes the form

$$e = \frac{2\pi^2 An}{N} \sum_{k=1}^{\infty} (-1)^k \left[ k^2 \left( \frac{\varepsilon^{-\alpha t}}{\alpha - \frac{k^2\pi^2}{RC_e}} - \frac{\varepsilon^{-\beta t}}{\beta - \frac{k^2\pi^2}{RC_e}} \right) - \frac{(\beta-\alpha)k^2 \varepsilon^{-k^2\pi^2 t/RC_e}}{\left(\alpha - \frac{k^2\pi^2}{RC_e}\right)\left(\beta - \frac{k^2\pi^2}{RC_e}\right)} \right]$$

instead of the expression $e = \frac{n}{N} A\,(\varepsilon^{-\alpha t} - \varepsilon^{-\beta t})$, where $\frac{n}{N}$ is

*Mr Howard is with the National Physical Laboratory, Teddington.

the ratio of the number of divider sections in the low voltage arm and N is the total number of divider sections.

The influence of earth capacitance can be summarised as follows:

(1) The effect of increasing the time-constant $RC_e$ is to lengthen the recorded duration of the wave-front and wave-tail, and to reduce the peak amplitude,

(2) For a given value of $RC_e$, the error in the peak amptitude increases as the wave-tail length decreases.

Fig. 3 gives the errors in peak amplitude, and the duration of the recorded wave-front for 1/5 and 1/50 microsecond waves as functions of the time constant ($RC_e$) of the high-voltage arm of the resistor divider. For a peak amplitude error of less than one per cent, the time constant must not be greater than 3 microseconds for a 1/50 microsecond wave and one microsecond for a 1/5 microsecond wave; the corresponding recorded wave-fronts for the two conditions are 2·2 and 1·2 microseconds respectively. This increase in the wave-front represents a serious modification to the shape of the front of the wave, and if the divider is used to record a sudden collapse of voltage occurring before the peak value is reached, the voltage measured is likely to be considerably less than the true value.

## *Resistance Divider Earth Capacitance*

The earth capacitance of a divider may be estimated from the formula previously given (details given in the first article of the series published in the ELECTRICAL TIMES of 14th April), or measured by means of a Schering-bridge network in which one side of the detector is earthed; allowance must be made for the measured capacitance of the alternating source and leads, etc. Since the capacitance is governed by the physical size of the divider, the length of which is related to the peak voltage to be measured, the errors vary approximately as the square of the voltage rating. For a given voltage the response of the divider can only be improved by reducing the resistance or by providing a special high-voltage electrode to eliminate earth-capacitance. The lower limit of resistance is imposed by the impulse generator since too low a value affects the wave-tail of the impulse wave and the generator voltage efficiency. The earth-capacitance of a 2,000 kV divider (approximately 16 ft long) is of the order of 80$\mu\mu$F so that the upper resistance limit for one per cent errors in the measured peak amplitudes of 1/50 and 1/5 microsecond waves are 37,000 and 12,000 ohms respectively; in practice these values of resistance are unlikely to cause trouble from the points of view of impulse wave-tail and generator efficiency.

The earth capacitance effect can be eliminated by placing the divider in a uniform field, and if the inductive time-constants (L/R) of the high- and low-voltage arms of the divider are the same, the shape and peak amplitude of the output wave from the impulse generator are faithfully recorded. The required field may be obtained by locating the divider near the electrostatic field produced by the impulse generator, by surrounding the divider with a resistive screen, or by providing a metallic electrode, at the high-voltage end of the divider, similar to that employed in the case of alternating voltage measurements. Radiation from the generator introduces high-frequency disturbances into the wave-front, and this precludes the use of the generator as a source of uniform electrostatic field; of the two remaining methods, the required conditions are achieved more easily with a high-voltage electrode than with a resistive screen. Fig. 4 shows the capacitive voltage distribution along the divider resulting from earth capacitance, the ideal uniform distribution and the actual distribution obtained with the conical electrode arrangement shown. This shield is only required when recording waves having durations less than one microsecond, or for the measurement of the peak value in cases where the time-constant ($RC_e$) is excessive; the arrangement gives errors between 2 and 3% for waves chopped on the front of standard wave-forms.

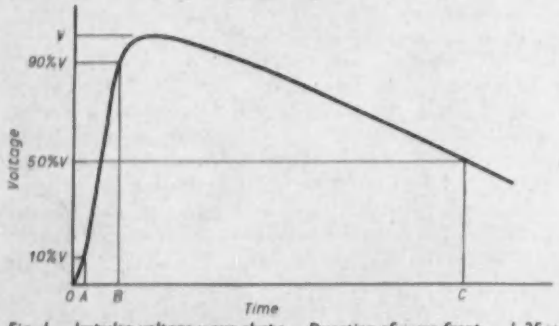



*Fig. 1. Impulse-voltage wave-shape. Duration of wave front = 1·25 × the time interval AB. Duration of wave-tail = time to half-value of wave = time interval OC*

## *Resistor Construction*

Resistor units should be of the non-inductive wire wound type and preferably immersed in transformer oil to reduce the risk of flashover between adjacent turns; a similar method of construction, without oil immersion, should be employed for the low-voltage arm of the divider to ensure that the inductive time constant is the same for the low- and high-voltage arms of the divider. If the time constant of the low-voltage arm exceeds that of the high-voltage arm, voltage overshoot occurs across the low-voltage arm; stray capacitance associated with this residual inductance produces oscillatory disturbances on the recorded wave-front. The leads joining the two parts of the divider must also be kept as short as possible to keep down inductance. Carbon type resistors are not suitable for impulse measurements owing to their changing characteristics with high transient voltages and currents (a 12,000 ohm resistor used for 2,000 kV impulses passes peak currents of 17 amps). When designing resistors the temperature coefficient of resistance of the wire, and the temperature rise under impulse conditions must not be overlooked. The total energy dissipated when a resistor is subjected to a voltage of the form $v = V e^{-t/T}$ (this shape is mathematically easier to deal with than $A(\varepsilon^{-\alpha t} - \varepsilon^{-\beta t})$ and only a small error results from

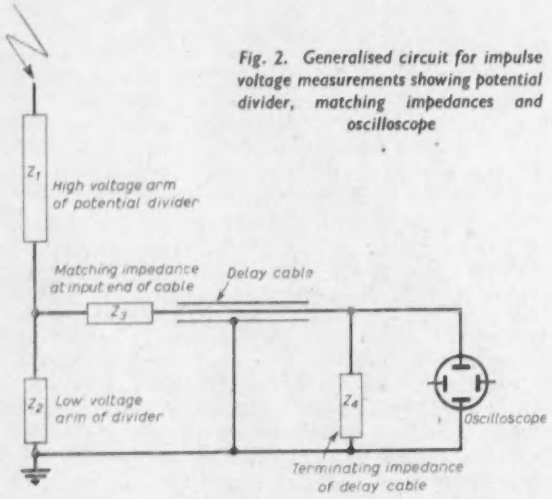



*Fig. 2. Generalised circuit for impulse voltage measurements showing potential divider, matching impedances and oscilloscope*

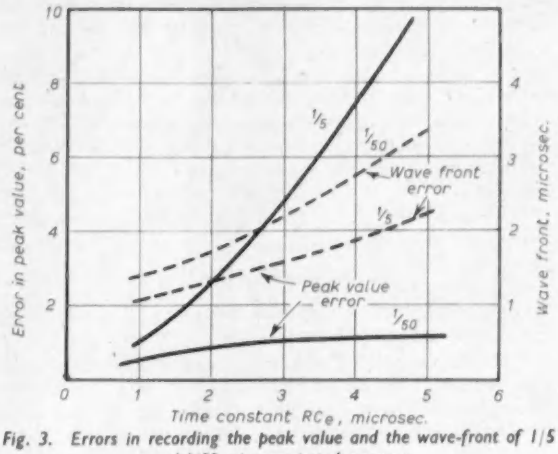



*Fig. 3. Errors in recording the peak value and the wave-front of 1/5 and 1/50 microsec impulse waves*

its use) is given by:

$$\frac{V^2}{R}\int_0^{\infty} \epsilon^{-2t/T}\,dt = \frac{V^2T}{2R} \text{ joules.}$$

where R is the resistance in ohms and T is the time-constant (in sec.) of the impulse wave.

A suitable high-voltage resistor and a screened low-voltage unit made of the same resistance material has been described, screening eliminates spurious capacitive voltage pick-up.

## Capacitor Divider

With perfect capacitors (non-inductive) having only capacitance to earth, the voltage appearing across the low-voltage arm of the divider is given by:

$$e = \frac{n}{N} A \left(1 - \frac{C_e}{6C_s}\right)(\epsilon^{-\alpha t} - \epsilon^{-\beta t})$$

instead of $A(\epsilon^{-\alpha t} - \epsilon^{-\beta t})$

where $C_e$ = earth capacitance and $C_s$ = series capacitance of the divider.

The capacitance divider, therefore, reproduces phenomena of any wave-shape and frequency with a constant error; so long as $\frac{C_e}{C_s}$ does not exceed 0·05, the error in the recorded wave will not exceed one per cent. There is no objection to a divider having a relatively large error if it is accurately known, except that, under these conditions, the series capacitance is usually small and the positions of earthed and high-voltage objects would therefore have greater influence on the divider ratio. A suitable value for the series capacitance is approximately 300 x $10^{-12}$ F.

Residual inductance in the low-voltage arm is more troublesome with capacitor than with resistor dividers; inductive capacitors or long leads joining the low- and high-voltage arms of the divider introduce serious oscillatory disturbances in the recorded wave-shape. Bushing suppressor type capacitors are suitable for the low-voltage arm.

The high cost of good quality capacitors, the difficulties experienced in making them readily mobile, and the special circuit arrangements which have to be employed when the divider is used in conjunction with a delay cable, often make the resistor divider preferable.

## Delay Cable

The low voltage arm of the divider is usually connected to the oscillograph by a length of coaxial cable. This may vary in length from a few metres to a hundred or so metres, when, for convenience a delay between the operation of the generator and the arrival of the signal at the oscillograph is required; its length may also be governed by reasons of safety.

For a resistor divider the cable may be terminated by a resistor equal in value to the surge impedance of the cable but with a capacitor divider the termination is usually more complicated; the case of the resistor divider is considered first.

The cable can introduce errors into the recorded peak amplitude and wave-shape through:

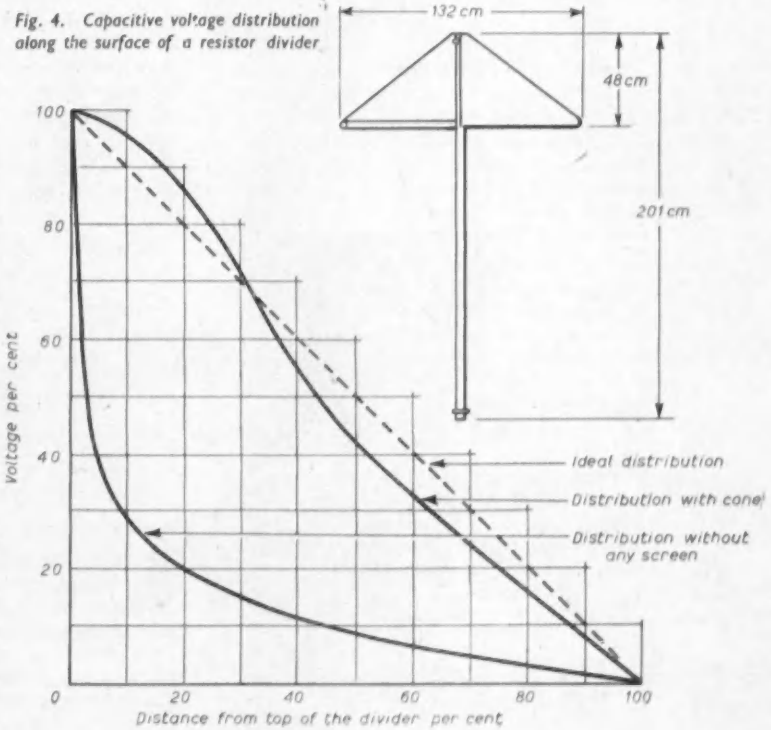
(*a*) cable attentuation,
(*b*) impurities in the cable termination, such as shunt capacitance and inductance,
(*c*) the use of a pure resistor, equal to the surge impedance, to terminate and match a transmission line possessing four parameters (resistance, inductance, capacitance and leakage conductance per unit length).

Attenuation arises from skin effects associated with the inner and outer conductors; if low-loss dielectrics are employed for insulation their influence can be neglected. At high frequencies the total resistance per unit length of a non-magnetic coaxial line is

$$\rho = \sqrt{\frac{(\mu_o f)}{4\pi}}\left[\frac{1}{r_a\sqrt{\delta_a}} - \frac{1}{r_b\sqrt{\delta_b}}\right]$$

$$= \sqrt{\frac{\omega}{2\pi.\,10^7}}\left[\frac{1}{r_a\sqrt{\delta_a}} + \frac{1}{r_b\sqrt{\delta_b}}\right] = k\sqrt{\omega} \text{ ohms/metre}$$

*Fig. 4. Capacitive voltage distribution along the surface of a resistor divider*



where $r_a$ and $r_b$ are respectively the outside radius of the inner conductor and the inner radius of the outer conductor, $\delta_a$ and $\delta_b$ the corresponding conductivies and $\mu_o$ is the permeability of free space ($=4\pi\times10^{-7}$ henry/metre).

For the transient state $\sqrt{\omega}$ may be replaced by $1/\sqrt{t}$ and the attenuation, which is given by $V/V_o=\varepsilon^{-\rho y/2Z}$ where y is the distance travelled, becomes $V/V_o=\varepsilon^{-ky/2Z\sqrt{t}}$ for a unit function wave. The attenuation with any other waveform may be determined by the use of Duhamel's Integral. As an illustration of the effect of the size of cable on the recording errors, Fig. 5 gives the response of 0·5 microsecond-delay lengths of two cables to a voltage of the form $V=a_ot$ (uniformly rising wave-front). The curves show that for voltage measurements involving full waves, such as the standard 1/50 microsecond wave, both delay cables are suitable; for waves which are chopped on the front, and in times less than 0·5 microsecond, the smaller cable is definitely not suitable.

The attentuation can be measured experimentally and this discussed in detail by Tropper [2]; the circuit arrangement is shown in Fig. 6. The capacitance C is charged to a known voltage V and discharged, by closing the switch, through the resistance arrangement consisting of $R_1$, $R_2$ and the surge impedance of the cable Z. The wave-front of the impulse wave produced is controlled by the inductance L and the magnitude of this is usually arranged so that the front is a convenient value, say 1 microsecond; the resistances, in the main, control the tail.

The voltage impulse entering the delay cable can be expressed operationally in the form

$$v(p)=\frac{ZV}{(Z+R_2)}\cdot\frac{R}{L}\cdot\frac{p}{p^2+Rp/L+1/LC}\cdot I$$

where $$R=\frac{R_1(R_2+Z)}{R_1+R_2+Z}$$

as a function of t by

$$v(t)=\frac{Z.V}{(Z+R_2)}\cdot\frac{\alpha+\beta}{\beta-\alpha}\cdot(\varepsilon^{-\alpha t}-\varepsilon^{-\beta t})$$

If the various quantities are arranged to give a standard 1/50 microsecond wave then the constants $\alpha$ and $\beta$ can be obtained from standard curves; for a 1/50 microsecond wave $\alpha=1{\cdot}4\times10^4$ and $\beta=5{\cdot}98\times10^6$. Comparing the peak value of v(t) with the voltage measured by the oscillograph gives a measure of the cable attenuation; the ratio of the two voltages is equal to $\varepsilon^{-\rho y/2Z}$.

Böckman and Hylten-Cavallius[3] have examined the effect of inductive and capacitive termination impurities, and have shown that errors introduced are negligible if the time-constant L/R of the terminal resistor is less than $4\times10^{-2}$ microsecond, the inductance of the connections to the oscillograph plates is of the order of $2\times10^{-1}$ $\mu$H and the capacitance of the plates and associated leads less than 40$\mu\mu$F. Tropper[2] has considered the effects of capacitive shunting of the terminal resistor and has found that the error can be neglected if the RC time-constant is less than $3\times10^{-3}$ microsecond. The errors arising from the use of a resistor to terminate the cable are dealt with in an E.R.A. publication[4]; for normal impulse waves the errors are very small. Tropper[2] does recommend the use of double matching i.e. matching the delay cable at both ends ($Z=Z_3+\frac{Z_1 Z_2}{Z_1+Z_2}$ at delay cable input, Fig 2) to reduce the magnitude of residual waves which might be produced by the various factors mentioned under (*b*) and (*c*).

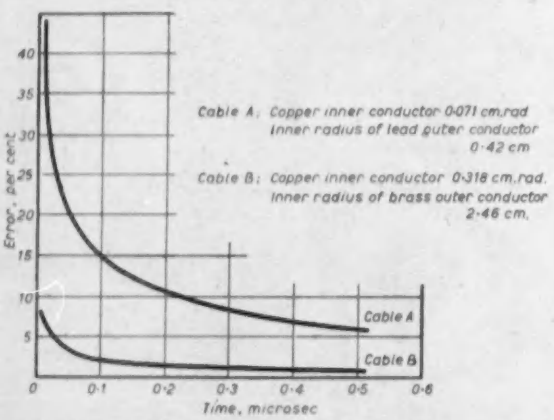



*Fig. 5. Response of 0·5 microsec lengths of delay cables to a voltage of the form of $V=a_ot$*

The surge impedance of a delay cable may be determined experimentally by means of the circuit shown in Fig. 7. The cable is charged up to a suitable voltage and then earthed through the resistance R. A discharge wave travels along the cable and is reflected at the oscillograph plates back to the resistance R; if R is not equal to the surge impedance it will again be reflected and the wave surges to and fro along the cable until attenuation finally reduces its magnitude. If the value of R is equal to the surge impedance then no reflection occurs and the wave is completely absorbed at the input end; in this case the oscillograph shows the voltage applied to the cable up to the time of arrival of the discharge wave when the voltage collapses to and remains zero.

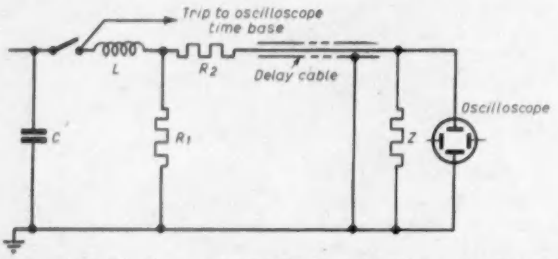



*Fig. 6. Circuit for the experimental determination of the attenuation of a delay cable*

## *Capacitor Divider Circuits with Delay Cables*

When a delay cable is used in conjunction with a capacitance divider there are two usual forms of circuit arrangement; these are shown in Fig. 8. For mathematical convenience consider a unit-function voltage applied to arrangement (*a*), a fraction $\frac{C_1}{2(C_1+C_2)}$ is injected into the delay cable. Doubling by reflection occurs at the oscillograph end, and initially the voltage jumps to the fraction $\frac{C_1}{(C_1+C_2)}$; the reflected wave is absorbed with negligible reflection at the input end. After infinite time the delay cable behaves as a pure capacitance, and the voltage at the oscillograph falls to the fraction $\frac{C_1}{(C_1+C_2+C_k)}$; thus the delay cable introduces a difference of $C_1 C_k/C_2^2$ (if $C_2>C_1>C_k$) between the initial and infinite-time values. Burch[5] illustrated how this error could be reduced by transferring part of the low-voltage capacitance to the oscillograph end of the cable and connecting it in series with a resistor equal to the surge impedance of the cable, as shown in arrangement (*b*). If $C_1+C_2=C_3+C_k$ then the initial and infinite

time values of voltage are the same. Errors do occur at intermediate times but these can be neglected. For example if $\frac{C_k}{(C_1+C_2)}=0{\cdot}1$ then the maximum variation for the arrangement (*a*) is 10% and for arrangement (*b*), where $\frac{C_k}{(C_1+C_2+C_3)}=0{\cdot}1$, it is 1·5%.

## *Miscellaneous Recording Methods*

Bowdler[6] has described a method of measuring the peak values and duration time of impulse voltages. A fraction of the high voltage, derived from the low voltage arm of a resistor or capacitor divider, is applied through a rectifier to a capacitor (C); this capacitor then discharges through a ballistic galvanometer and the peak voltage is calculated from the relation V (peak)=Q/C, where Q is the quantity of electricity measured. Time-lag or duration time measurements are carried out by measuring the time for which the impulse voltage exceeds a certain controlled value; this is carried out by a separate circuit and is referred to as a ballistic chronometer. Agreement with oscillograph methods in peak voltage measurement to within 2%, even with voltages having a duration of the order of $10^{-7}$ sec, and in time-lag or duration measurements to within 0·2 microsecond is claimed. The measurements are not critically dependent on the characteristics of the thermionic values used in the circuits.

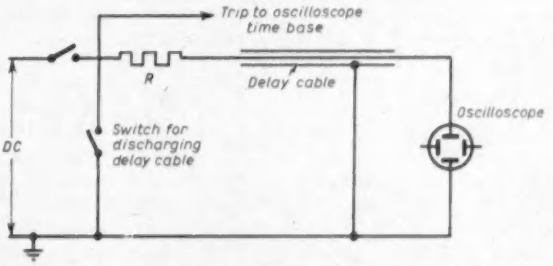



*Fig. 7. Circuit for the experimental determination of the surge impedance of a delay cable*

The use of a ballistic galvanometer is somewhat troublesome for practical applications; Rabus[7] has described an arrangement which uses an electrostatic voltmeter. The circuit consists of a capacitor $C_a$ (about $15\times10^{-12}$F) which is charged up by means of a rectifier to the fraction of the peak value of the impulse voltage appearing across the low voltage arm of a divider. An electrostatic voltmeter, in parallel with a capacitor $C_b$ ($300-600\times10^{-12}$F), is connected to $C_a$ through a 1,000 megohm blocking resistor. The capacitor $C_a$ is charged up to between 3 and 6 kV and it then discharges into capacitor $C_b$; the peak voltage of the impulse can then be recorded by a voltmeter indicating between 150 and 300 V. The accuracy is about 1% for full waves and between 1 and 3% for a wave chopped in times which are not less than 0·5 microsec; the electrostatic voltmeter can be easily read since it discharges only 0·2% in approximately five seconds.

An electronic peak voltmeter has been developed by Bryant and Newman[8]. The voltage is first determined to within 10% by suitable biasing of ten electronic units and then the instrument is switched to cover the relevant 10% in steps of 1%.

A number of instruments, variations of the two types described, have been developed; the main advantage of these instruments is that they facilitate rapid measurements

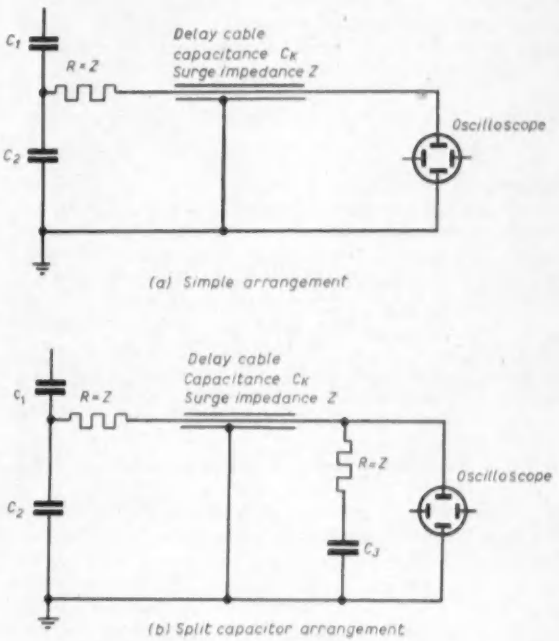



*Fig. 8. Capacitor divider circuits showing (a) the simple arrangement and (b) the split capacitor arrangement*

of peak values in repetition work where the wave-shape has first been checked by an oscillograph method.

## *Sphere-Gap*

The same conditions and comments including those concerning air density, outlined, for alternating and direct voltages, apply when sphere-gaps are used to measure impulse voltages; there are, however, one or two other important considerations.

B.S.S.358:1939 recommends the gap should be irradiated when impulse voltages of less than 50 kV peak are being measured. However, Meek[9, 10], has shown that irradiation is required for gaps used to measure much higher voltages if consistent results are required. The need for irradiation arises from the time-lag required in spark development; this is made up of:

(*a*) the statistical time-lag caused by the necessity for an electron to appear in the gap to initiate breakdown during voltage application,

and (*b*) the formative time-lag, which is the time for the build up of the spark process.

The statistical time-lag is governed by irradiation. Under impulse conditions the gap will break down when the impulse peak exceeds the d.c. breakdown value if there is an electron in the gap to initiate the spark when the peak is reached. Too little irradiation may result in it being necessary to maintain the impulse wave above the d.c. breakdown value for a longer period to give an increased chance for electron appearance. The impulse breakdown voltage of a fixed gap usually increases as irradiation is decreased. Normally 0·5—1·0 mg of radium inserted in the high-voltage sphere is adequate, but for small gaps and voltages of a few kV it may be necessary to use a spark from a neighbouring source as a means of illuminating the measuring gap.

The sphere-gap will not respond to the peak of impulse waves which are underdamped; this is to be expected since

the time for which the voltage remains within a given percentage of the peak is small. It is not uncommon for workers who do not possess oscillograph equipment or who calibrate the oscillograph against the sphere-gap, to use an impulse wave which is not properly damped; the result is that the true peak value is higher than that recorded by the sphere-gap.

The spurious and low value flashovers which occur, owing to air pollution, etc., with power frequency and direct voltages are less troublesome with impulse voltages.

Note.—In connection with the previous article, of the series (14th April, 1955), the author has been informed by Messrs Everett Edgcumbe Ltd. that by far the largest number of electrostatic voltmeters of the Abraham-Villard type have been manufactured for the ranges 5-60 kV, 5-120 kV and 7·5-200 kV. The model with the range 10-300 kV has recently attracted more attention; the instrument extending up to 500 kV has only been supplied on a few occasions.

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# Applications for Germanium Transistors

PARALLELING the development of the germanium junction transistor is the rapid exploration of applications for these devices and the group of papers on this subject at last week's meeting of the I.E.E. Radio Section provided a useful indication of some of their possibilities. A particular field of study is that of transistor photoconductivity and the development of suitable photo-electric cells, and the paper by J. M. Waddell, S. E. Mayer and S. Kaye described a new type of germanium-junction cell in which the junction is manufactured by impurity diffusion.

In operation, germanium photo-cells differ from the well-known copper oxide and selenium barrier-layer types, in which power is obtained from the light beam itself by utilising the voltage built up across the rectifying barrier when light falls on to the material near this barrier. In contrast the germanium cell is operated in the photoconductive mode with the barrier biassed in the reverse direction to overcome the low resistivity of germanium in the dark and hence to make the dark current comparable with or less than the light current. Of the types of germanium barrier available, the p-n junction-type photocell has the lowest dark current and the highest working voltage and, by virtue of its ability to produce one electron in the internal circuit for each photon absorbed immediately adjacent to the barrier, is also capable of a high and stable sensitivity. For these reasons the simple p-n junction photo diodes were chosen for this development.

The sensitivity of the p-n photocell, however, is a maximum only in the neighbourhood of the barrier. It is thus possible to make one side of the junction so thin that the light can be made to impinge on the junction through it, but this method has a correspondingly deleterious effect on the transistor's properties. In the system described, therefore, the transistor was made as a block 0·06 in. by 0·035 in. by 0·02 in., the junction being parallel to the largest face and the light directed on to its edge. To compensate for the smaller diffusion length of electrons in the p. layer, this was made only 0·006 in. thick, and the n. layer 0·014 in. thick. Its construction had also to give careful consideration to thermal stability, since the temperature coefficient of resistance under reverse conditions is negative and reverse runaway can take place should the device exceed a critical temperature.

The manufacture of the transistor itself is particularly interesting, since (as mentioned earlier) the diffused impurity technique was employed to give a high electrical quality and to facilitate large-scale production. The method not only produces uniform plane junctions of any desired dimensions, but enables virtually the entire single crystal ingot of germanium to be used for junction making. In the process, the ingot (suitably prepared to be, say, n. type) is cut into slices, one face of each slice then being coated with a suitable acceptor impurity—in this case, gold. Subjection of the slice to heating then causes the diffusion of the impurity into it to any required depth. Photocells made by this process were found to have a low noise level and to respond to light of all wavelengths up to approximately two microns ($2 \times 10^4$ Å).

Applications for such transistors range from industrial uses requiring a simple "on-off" device to detecting modulated light beams, as in sound film projectors. It also opens up considerable possibilities in the use of infra-red light beams for communication in the field and at sea, where its low noise level makes a substantial increase in range possible. With a suitable high-elevel, infra-red modulator a range of some tens of miles is not beyond reach. It is also suggested for use in a magnetic-amplifier circuit to bring about the change in current necessary to saturate the core of a suitable coil in the circuit, and for reading holes in punched cards and teleprinter tapes.

## *Power Amplifiers*

Many applications where transistors can be used to advantage also require that large output powers be handled, and a paper by R. A. Hilbourne and D. D. Jones discussed the power handling capabilities of p-n-p. junction transistors in sinusoidal amplifiers. By virtue of its high efficiency, the transistor can be used to advantage in such circuits and its maximum power output is not necessarily limited by the maximum collector dissipation rating. In certain non-sinusoidal applications, however, the collector dissipation does set the limit, but, as it is possible for the mean output power to be many times the mean power dissipated in the transistor, its use as an efficient current switch for relay operation has important potentialities.

Moreover, where distortion is unimpotrant, this type of transistor is also eminently suited for converting d.c. at low voltage to d.c. at high voltage, and this application was considered by L. H. Light and P. M. Hooker who described a transistor relaxation-oscillator circuit in which the transistor acts as an interrupter in a l.v. circuit. Energy is stored in the "on" period in transformer inductance, and released at an increased voltage in the "off" period. Applications considered included a miniature converter for supplying h.t. in hearing aids and a larger unit generating a 500-700 V supply for Geiger-Müller counters.

# *Efficiency and the Load Factor*

**Sir John Hacking predicts rapid advances at E.D.A. Luncheon**

OUTSTANDING feature of the E.D.A. Annual Luncheon, held in London last week, was the speech by the retiring president, Sir John Hacking, in which he forecast rapid improvements in efficiency of generation in British power stations. He began by saying that the growth of the electrical industry was matched only by that of the chemical industry. Energy in electrical form had been responsible for much of the growth of modern civilisation.

Sir John remarked that it was unlikely that the results of the coming election would modify the prospects of the electricity supply industry. Responsible people in both parties seemed to have the growth of electricity in mind. The industry had endured many committees of enquiry, and in the long run these no doubt did good, but while they were sitting they were a disturbing influence and it was idle to think that they did not slow down progress.

## *Thermal Efficiencies*

One effect of the plant shortage was that it lowered the average thermal efficiency of generation, and in this way had an effect on tariffs. In 1947-48, the average efficiency was just over 20·8%, and in the next three years it rose only slowly to an average of 22%. In the next two years the average rate of increase was 0·66%. 1953-54 saw an average of 23·4%, and it was probable that for the year just ended the average would be not less than 24%. The industry could confidently look forward to achieving by 1960 a figure substantially in advance of the 26% forecast three years ago.

It was worth noting that the average for all U.S. stations is 28%. Sir John said that he knew of two large utilities there with an average efficiency better than 30%, and with some individual plants of 38% efficiency. Some of the plants under construction in this country would achieve that figure.

Before the war the efficiency figure in this country was much the same as in the U.S.A.; that country had been able to make greater progress than Great Britain because it suffered fewer interruptions due to war effort and bombing.

In terms of coal, the effect of efficiency improvements would be that the industry would consume in 1958, 10% less than on the 1954 basis, and 20% less than on the 1948 basis. However, this improvement had to be paid for heavily in terms of plant cost. In 1954 one-third of the total capacity had been commissioned after 1937. By 1958, this figure would be increased to one-half. By then, plant charges per kilowatt would have risen to 20% above 1954. One way of offsetting this was to increase the load factor: the importance of so doing was appreciated by the industry. Such action would become of considerable importance in the next four years, and in that respect most area boards had offered reduced charges for night loads.

## *Shift Working*

Commenting on the poor load factor of the industrial consumer with single-shift working, Sir John suggested that the growth of electronic devices might produce an improvement. It opened up the possibility of carrying out many mechanical operations without men in attendance. The capital cost of such plant would be high, but it would be economic to work it for long hours, with beneficial effects on the load factor. The industry, he thought, had to continue to encourage and educate potential users of electricity so that the full benefit would accrue to the nation as a whole.

Concluding his remarks on E.D.A.'s work, Sir John touched on agriculture, suggesting that it was worth the while of area boards to appoint salesmen who had direct personal experience of agriculture.

Earlier, Lord Jowitt had spoken. He said it was desirable for the electricity supply industry to be publicly owned so long as there was keen competition at the consumers' end. The development of the whole electrical industry was a success story in every way: the accomplishments of the supply industry in the last few years had been very remarkable. Particularly was this so in the country, where the supply of electrical energy to farms and cottages was one of the few ways of counteracting the draw of the towns. However, there was a need for the farmer to make more use of his electricity supply in his farming operations.

## *The Future*

In looking at these achievements, saturation seemed to be farther away today than ever before. Nuclear power was becoming available to replace fossil fuels when they became too rare. The 10-year programme announced by the Government seemed a good and ambitious one, larger than that in any other country. But the programme would give nothing like what was needed. In the second 10 years it would be necessary to strain every nerve to get the maximum output. Britain had to lead the world in the peaceful uses of nuclear energy.

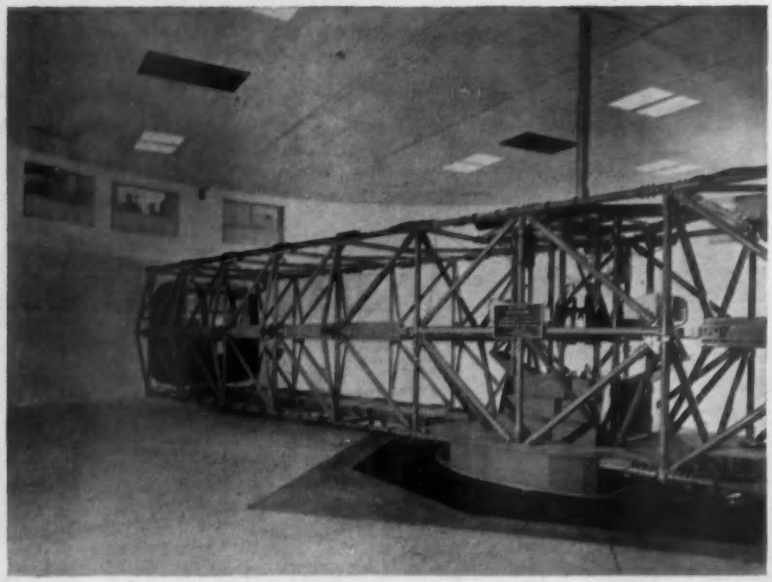
Mr L. W. Joynson-Hicks, Parliamentary Secretary, Ministry of Fuel and Power was the last speaker at the luncheon. He thanked the industry as a whole, on behalf of the Minister and himself, for the kindnesses they had shown during his term of office. Three-and-half years ago the industry had not settled down: now it had found its place in the present scheme of things. The various fuel industries were in competition, but not unbridled competition.

The Parliamentary Secretary paid tribute to the E.A.W., making mention particularly of Dame Caroline Haslett.

*Mr V. A. Pask seen with Lady Swaythling and Mr and Mrs C. R. King*

# TESTING HUMAN BEHAVIOUR AT HIGH 'G'

## Man-Carrying Centrifuge at R.A.E., Farnborough



*The man-carrying centrifuge at the Institute of Aviation Medicine, Farnborough, showing the windows of the control room in the wall of the centrifuge chamber. M. B. Wild and Co. Ltd. acted as main contractors, all the electrical plant and control gear being supplied by the G.E.C.*

*The observers at the centre of the man-carrying centrifuge at the Institute of Aviation Medicine, Farnborough. "Teletalk" apparatus enables him to speak to the controller, recorder and subject*

OPENED earlier this week was the man-carrying centrifuge at the R.A.F. Institute of Aviation Medicine at the Royal Aircraft Establishment, Farnborough. This equipment has been designed to permit detailed study of the behaviour of both men and equipment at accelerations up to 30 g, although for human beings the centrifuge is restricted to a maximum of 10 g or, where prone or supine pilot positions are to be investigated this can be increased to 12 or 15 g.

Basically, the equipment consists of a horizontal arm of tubular steel construction, rotating under a precisely controlled cycle of acceleration and deceleration. The arm, which is just over 60 ft long has a car suspended at each end, and is mounted on a 12 ton flywheel attached to a vertical spindle driving motor installed in a central pit in the centrifuge chamber. At each end of the arm, is located a car weighing 1,150 lb which can be accelerated up to more than 115 m.p.h. Alternatively, 1½ ton cars can be installed to provide space for the subject to carry out physical tasks such as putting on parachute harness and so forth. Under these conditions, the maximum "g" attained is 10.

### *Operation*

The centrifuge can be operated either automatically or manually by a controller seated at his desk in the control room, or by the subjects, if two are concerned, in the cars themselves, in which case the speed automatically follows the lower of the two settings. The observers, who are stationed near the centre of rotation, and look outward to the subjects can also exercise control and bring the machine to rest.

The subject is always in communication by microphone and loudspeaker with the observer, and the observer in turn is in two-way communication with the controller and the recorder—the former in a control room which has an overall view of the whole arm, and the latter in a laboratory on the roof of the building.

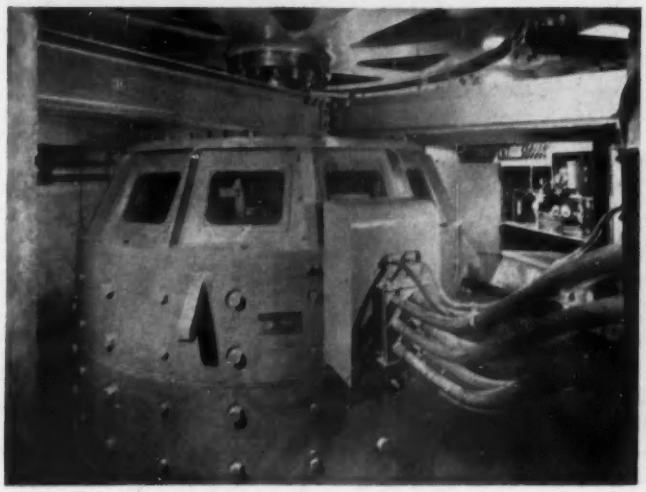
The routine through which the centrifuge progresses is established by means of a number of interchangeable cams, each of which is designed to give a different maximum "g" with a different rate of acceleration from rest. The cam revolves, operating the control system, until the required "g" is attained, remains stationary for a predetermined time—usually a few seconds—and then is reversed in its direction of rotation to decelerate the centrifuge and bring it to rest. The cam may be driven at four speeds, enabling the required "g" to be reached in a run up time of 9, 12, 18 or 30 seconds. In practice a cam profile can be used in which the major part of "g" increase can be located within the last two seconds of the run up cycle to give a rate of increase of about 5 g/sec.

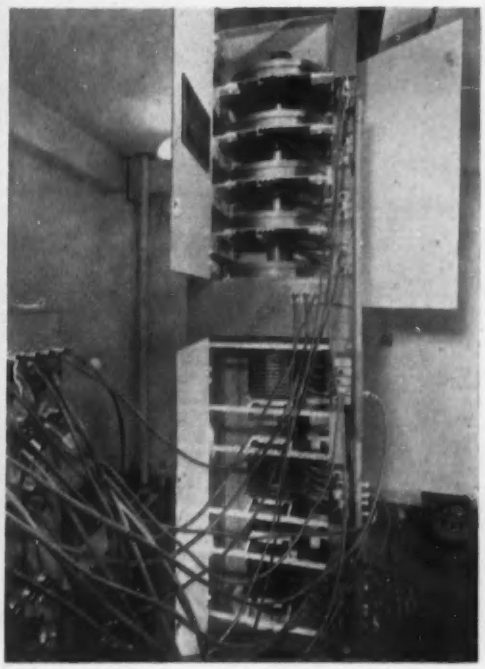
Power for the driving motor is derived from a motor generator set consisting of a 1,250 h.p. induction motor fed at 6·6 kV 3-phase, driving a 1,950 kW max rating, 760 V, d.c. generator. Also on the same set is the exciter for the main d.c. centrifuge motor. This latter item is a vertical spindle d.c. machine having an overall weight of 46 tons. It is supported on a stool which houses an extension shaft carrying a group of 25 slip-rings. The motor shaft is hollow, and carries leads from these slip-rings to the rotating structure which is mounted, on top of the

flywheel. Half of these slip-rings are rated at 60 amps, and the remainder at 30 amps. The motor is rated at 1,350 h.p., 54 r.p.m. At the bottom of the extension shaft carrying the slip-rings is a gearbox of ratio 3:43 which drives two tacho-generators and three overspeed devices. The slip-rings carry control facilities, lighting and other services to the centrifuge arm, but the instrument indications from the subject are taken upward through a vertical column to a separate slip-ring assembly. This comprises 60 silver slip-rings and 30 mercury troughs for the various electro-medical and teletalk circuits. There are three banks of 20 rings and five banks, each of six troughs, arranged pancake fashion.

It is, of course, essential with equipment of this nature that elaborate precautions should be taken to ensure that no possible deviation from the established programme—apart from emergency stopping—shall occur, both to protect the subject and to establish consistency and repeatability of runs. The control equipment is consequently somewhat complex. The armature of the centrifuge motor is energised by the generator of the motor generator set and its field by the constant voltage exciter driven by the m.g. shaft. Variation of speed of the centrifuge motor is achieved by adjustment of the excitation of the d.c. generator, and this adjustment is made automatically by electronic equipment. Two separate signals are fed into this equipment, one derived from the geared tacho-generators which develop a voltage proportional to the speed of the arm. Two generators are used as a safety precaution, and any difference in their output operates a differential relay and shuts down the plant. The second signal comes from the cam unit and is proportional to the desired instantaneous speed. The difference between these signals constitutes the instanteous speed error. This error signal is passed to a two-stage valve amplifier, and thence to the control grid of a 3-phase thyratron rectifier which energises the field of the d.c. generator.

The cam units consist of two potentiometers, the sliding arms of which are actuated mechanically by the cam. Two potentiometers are again employed in the interests of safety. Two cams are used, one giving the run up and stopping programme (which can be changed) and a permanent stop cam giving a fixed stopping programme. This cam comes into operation by remote control, failure of the programme cam, or after expiration of the overall time limit. Under automatic control, the complete programme from start to stop can be carried out, with overriding control by the "controller," which wipes out the automatic run if it be exercised. Long runs may also be carried out under programme control. When the subject's or controller's joysticks take over manual control, they operate twin-torque transmitters which in turn actuate twin-torque receivers to give an equivalent movement to a follow-up drum controller. This is so arranged that





*Top left. Control room for the man-carrying centrifuge at the Institute of Aviation Medicine, Farnborough, showing G.E.C. control desk, teletalk amplifier unit and cam unit*

*Below left. The vertical spindle d.c. driving motor for man-carrying centrifuge*

*Below right. The slip-ring column for medical and "teletalk" circuits of the centrifuge*

all three operators must agree to raise speed, but any operator can lower speed. The joysticks have dead man's handles, and if any is released the controller is warned and can take over within five seconds. If he fails to do so the equipment shuts down. Even under manual control, however, the operation is limited by the cam controller.

Provision is made through coincidence transmitters for bringing the arm to rest at a specific "home" orientation, and arrangements are also made for inching.

Normally, the centrifuge retards electrically, but in the event of failure of equipment, or emergency, a hydraulic braking system comes into full operation. Under the usual running sequence, however, these brakes are only used as holding brakes in the home position.

There are, in addition, numerous other safety devices to guard against over-speed, over- torque, gearbox failure, and interlocks are provided on the car doors and the chamber doors.

### *Braking System*

The emergency braking system comprises eight fabric lined shoes equally spaced round the periphery of the cast steel ring or flywheel. Each shoe is operated by a hydraulic cylinder, alternate cylinders being supplied from separate hydraulic pressure circuits. The pressure units are located in cabinets in the wall of the motor pit, and each unit consists of an accumulator capable of storing sufficient fluid to make four emergency stops should pump motor supply be interrupted. Further protection is afforded by contacts in the main control circuit which ensure that the rotating arm cannot be started in the unlikely event of hydraulic pressure not being available. These contacts are closed by the accumulator pressure (as required for four applications of brakes).

Supply to the brake cylinders is through a dead weight loaded control valve. This weight is raised by means of a solenoid the pistons and brake shoes being retracted by direct acting springs.

Each accumulator is of the piston type using nitrogen, and is charged from a radial pump directly coupled to a 1 h.p. motor, and the normal operating pressure is 950 lb/sq in. (min.) to 1,250 lb/sq in. (max.).

In the event of emergency arising due to excessive out-of-balance in the loading of the rotating arm, steel rollers, carried in independent cast steel brackets, come into contact with the steel ring of the flywheel and hold the structure from excessive deflection, thus minimising damage to the motor bearings and the arm itself.

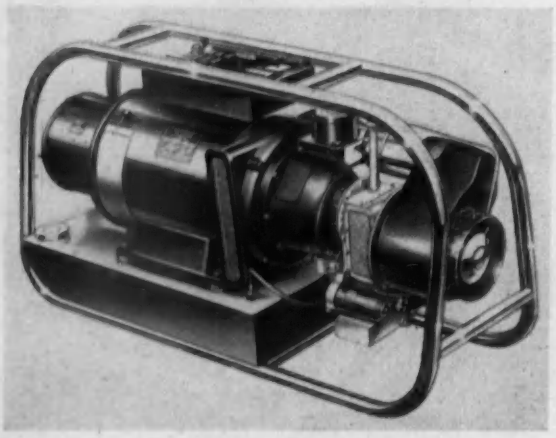
### *Instrumentation*

The recording of data, is carried out by pen recorder or photographically as required. Most of the information is in the form of minute voltages such as those emitted by heart or brain, or from sensitive transducers such as photocells, strain gauges and so on. These voltages are taken out through wires running along the centrifuge arm, and up to the amplifiers in the recording room via the slip-ring assembly. The extreme sensitivity of the amplifiers makes the complete screening of all wires essential, and many of the rooms in the building are completely screened by copper mesh in the walls, floor and ceiling, and sheet copper on the doors.

The main contractors for the centrifuge were Messrs M. B. Wild and Co., Ltd., with the General Electric Co. responsible for the control and electrical equipment. The electro-encephalograph was made by Messrs Edison Swan Electric Co., the camera recorder by Films and Equipments Ltd., and the amplifying equipment for the recording apparatus by Messrs Southern Instruments Ltd. Other equipment was supplied by Ferguson Pailin, Westinghouse Brake and Signal Co. and Troughton and Young.

# *British Small-Power Gas Turbine*

THAT the small-power industrial gas turbine has considerable potentialities in a variety of prime mover applications was particularly well indicated by the British made and developed 60 h.p. unit demonstrated by Rover Gas Turbines Ltd. at the B.I.F. It is now available coupled to various types of generator set for standby or power supply duty, aircraft ground starting or aircraft auxiliary work; in fact, as a suitable starting medium for any large turbine unit. Moreover, having a jet pipe temperature of 600° C, the turbine unit also makes available up to 1,250 B.Th.U./hr of exhaust heat which can be exploited.



*Rover's IS 60 gas turbine coupled to a 50 kVA Petbow alternator makes a mobile power unit which is immediately available*

Known as IS/60, the prime mover itself has, as its main structural member, the compressor housing with two, sideways facing, air intakes. Within the housing are contained the impellor, front main bearing and reduction gearing train through which the output is taken. This output is actually taken from the integral shaft of the intermediate wheel of this train, the full train driving the oil pump and fuel-control unit. A sheet metal compressed air receiver attached to the rear end of the compressor housing ducts air to the combustion chamber which, of the reverse flow type, thus houses the "Nimonic" alloy volute carrying the combustion gases to the turbine rotor. The rotor itself is an impulse type, the gases being introduced through a nozzle assembly. Liquid fuel consumption is 1·4 lb/b.h.p. hr, and a wide variety of distillate fuels and gases is acceptable.

As a mobile generator set, the turbine is coupled to a Petbow generator, which, for a.c. supplies delivers 50 kVA at 0·8 p.f. A d.c. version is also available. The alternator generates at a rated voltage of 440 V, 3-phase, being self-exciting and self-regulating to within ±2%. For aircraft work, generator sets employing 40 kVA Rotax machines or 50 kVA B.T.H. units are offered, whilst an instructional set, with a Heenan and Froude DP × 2 dynamometer, is available as a self-contained test bed installation for universities and technical colleges.

# Installation for Testing Pumps

## CATERING FOR STARTING VOLTAGE VARIANTS

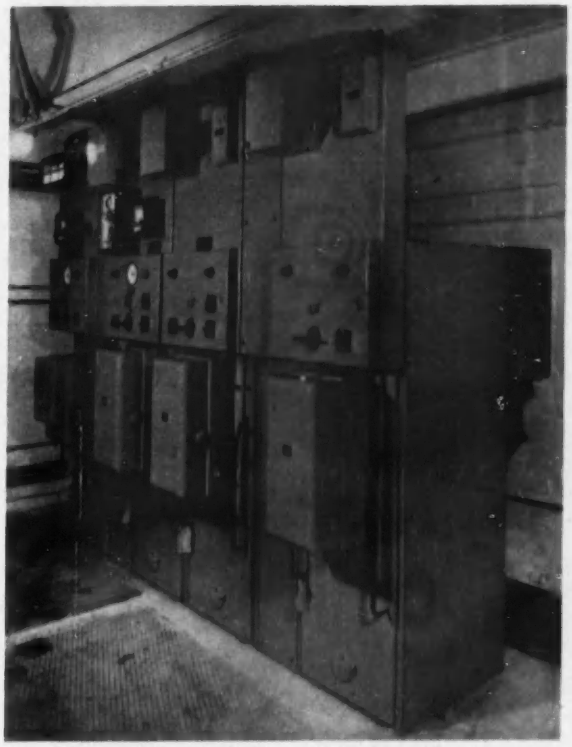
AS a result of increased demand for large centrifugal pumps for power stations and heavy industry it became necessary to provide additional testing facilities at the Team Valley works of Sigmund Pumps Ltd. The machines to be tested vary considerably in specification and as they are normally operated on site from a high-voltage supply, it was necessary to install starting equipment that would be suitable for a range of high voltage supplies and which would enable starting current to be restricted to the lowest possible levels. With these requirements in mind, the Contract Department of Crompton Parkinson Ltd. supplied equipment that could be employed for the automatic "Korndorffer" starting of motors having ratings between 500 h.p. and 2,000 h.p., and for any voltage between 1·8 kV and 6·6 kV. Briefly, the equipment installed comprises a 2,000 kVA outdoor transformer having 20 kV to 6/3/2 kV ratios by means of off-circuit taps, and an additional off-circuit tap for ±10% V, for the supply to the test plant. In addition a 4-unit ALA type metal-clad air-insulated switchboard of the vertical isolation pattern, and an auto-transformer of 2,000 kVA rating for the closed-circuit starting of motors were also supplied.

There were already extensive testing facilities in the works before it was decided to install the new test plant, and it was desirable, of course, to make as much use as possible of the existing test area. However, there was insufficient room on the test platform for "Korndorffer" starting equipment and it was therefore decided to arrange the ALA switchboard for automatic operation (solenoid pattern) and for remote control. The main bulk of the new test plant was subsequently installed in a room adjacent to the test area, and a control desk was erected on the existing test platform.

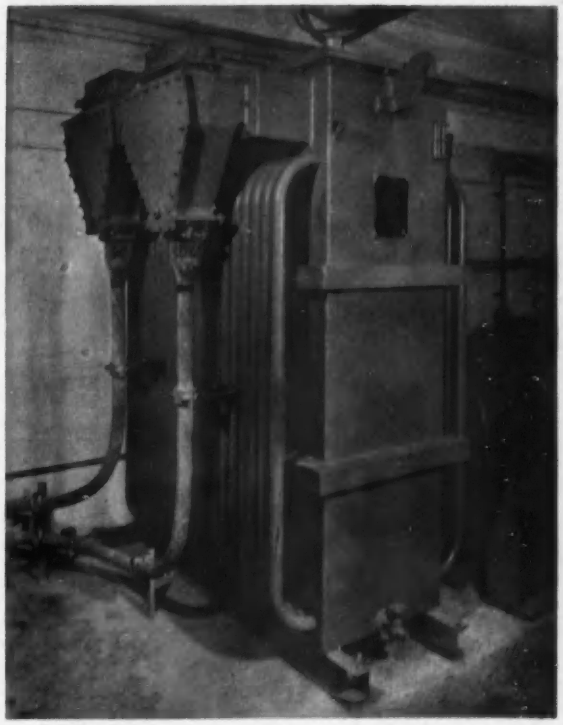
### *Protection*

Due to the wide range of motors for which test facilities had to be installed it was considered desirable to provide overall protection on the incoming unit together with independent protection for the machines under test. Safety features that have been incorporated, therefore, include over-current and earth-leakage protection for the switchboard, for the auto-transformer and for the equipment under test, and restricted earth-fault protection for the main transformer. Under-voltage protection, moreover, is incorporated for the switchboard and equipment under test, and a thermal-relay is employed having a wide range of settings and selected current-transformer ratios so that all reasonable protection can be afforded against overloading and single-phasing of motors up to the maximum rating of 2,000 h.p.

The installation of all main equipment was superintended by Crompton Parkinson Ltd. in collaboration with the Consulting Engineers for the project, R. W. Gregory and Partners (Newcastle upon Tyne), the complete test plant being commissioned a few weeks ago. There have already been several occasions on which the plant has been put in operation, and this installation brings the testing facilities of Sigmund Pumps Ltd. completely into line with the latest practice for testing the largest sizes of centrifugal pump equipment required for public utility and similar services, thus enabling all pumps produced at the works to be fully tested before despatch.



*Above, four-panel Crompton Parkington ALA type switchboard comprising supply and auto-transformer starting equipment. Below is the 2,000 kVA auto transformer for starting motors in the 500 to 2,000 h.p. range for any voltage between 1·8 and 6·6 kV*



# *Five-Day Week in Contracting?*

## Claims Put Forward at E.T.U. Conference

RATES of pay, a shorter working week and enrolment of women members were three of the main subjects, apart from political matters, which were discussed at the annual policy conference of the Electrical Trades Union which began at Worthing last Sunday. In his presidential address, Mr Frank Foulkes said there had been significant developments in recent wages negotiations. The majority of employers in the industries in which the union was interested had agreed to wage increases without the threat of strike action being used, and for the first time wage increases in the major industries during the last six months had been in keeping with the figures used in the official Interim Index of Retail Prices, but had not been sufficient to meet the actual increase in prices generally.

### *Eliminating Overtime*

Living standards could not be gauged accurately without consideration being given to the number of hours it was necessary to work to provide a decent existence, and throughout the whole of British Industry it had become increasingly necessary for systematic overtime to be arranged in order to maintain decent standards of living.

Alongside the fight for higher wages there should be a fight for a reduction in the number of hours of work. The inflated wage packet, due to the continuation of overtime working, was used by employers, during all wage negotiations, to offset justifiable demands for increases in the basic wage rates. It was necessary, therefore, to campaign against overtime working and for a shorter working week, even though this would entail a temporary lowering of the standard of living that had only been maintained by the working of systematic overtime.

During the year, the Executive Council had given very serious consideration to the position of women employed in industry generally and in the Electrical Manufacturing Industry in particular. There are over 7 million women employed in industry, with only 1,300,816 organised within the unions affiliated to Congress. In the Electrical Manufacturing section of the Engineering Industry there are 210,000 women, very few of whom were organised before the E.T.U.'s organising drive commenced. Considerable progress had been made in the few short months that the recruitment drive had been in operation (the annual report lists 10,167 female members out of a total of 215,596—compared with 8,397 in a total of 211,512 a year earlier).

On the matter of strikes, he said the union's members had been compelled to take strike action to obtain satisfaction in certain cases. The causes of the disputes and the Executive Council's attitude to its members in dispute, had been the subject of criticism in many quarters. The union's constitution encouraged initiative from below, he continued. The membership were intelligent and educated, and had the right to take any action on which they had decided by a majority vote in order to protect themselves from exploitation and ensure decent and comfortable living standards for themselves and their families.

Working conditions in the electrical contracting industry were among the issues debated at some length following the presidential address. The conference carried a composite resolution from five branches urging further negotiations with the National Federated Electrical Association and the Electrical Contracting Association of Scotland to secure a five-day working week in the electrical contracting industry. Mr D. A. Hill (Gloucester), proposing, said that the position at the moment was that the industrialists were using the contractors as cheap labour by having maintenance and other jobs done on a Saturday morning, instead of using their own workers or supply workers at overtime rates, he went on.

Mr L. F. Harmer (Hastings) successfully moved a resolution demanding that all labour under 21 years of age employed in the contracting sections of the C.E.A. should be apprentices. Electricity boards, he said, were using the young male labourers' clause in the supply agreement as a form of cheap labour. Those boys acted as mates to union members. Unfortunately, they were non-unionists, and not being apprentices, they were called up for National Service. Their jobs were then taken by fresh boys of 15 who were told they would be considered at a later date for indenturing as apprentices. But very few ever became apprentices, he asserted.

Stating that the Executive Council whole-heartedly supported the resolution, Mr J. Humphrey pointed out that the question of apprentices in contracting departments was bound up with the overall question of an agreement with C.E.A., which had not yet been resolved.

### *Apprentices*

Resolutions seeking an increase in the "present inadequate lodging allowance," and requesting the Executive Council to consider ways and means of inaugurating a superannuation scheme for members in the contracting industry were also carried. So, too, was a resolution calling for the removal of the employers' power to decide when operatives' annual paid holidays shall take place, and for full holiday credits during absence through sickness or accident.

The conference decided to press for an apprentice scheme for linesmen in the electricity supply industry.

The delegates also approved a resolution seeking a policy designed to limit the number of apprentices entering the trade by substantially reducing the present ratio of one apprentice to one journeyman. Another resolution, calling for a policy of nationalisation of the engineering industry, was referred back to the Executive Council.

On Monday morning the conference gave its unanimous support to a special Executive Council motion urging a vigorous campaign to "eliminate the menace" of constant and excessive overtime work.

Mr W. J. Pee successfully moved a resolution which "recognising that contracting electricians were dissatisfied with rates of pay, pressed the Executive Council to put forward a claim for a substantial increase for all sections of the trade. Resolutions calling for sick pay and superannuation or pension schemes were also carried. Negotiations to increase considerably the wages of electrical apprentices were urged, and the conference advocated the introduction of a five-day, 40-hour working week without pay reduction. A national rate in the contracting industry (using the London figure) was the subject of six resolutions which were referred back to the Council (although last year the late Walter Stevens told delegates that such a claim was unrealistic). Mr F. Haxell, general secretary, said the executive had conducted research into the whole question to establish the facts. A national rate was no easy matter to settle; such a policy would have to be pursued very carefully.

# notes on wiring

by Megohm

I HAVE just read with interest the Standard Specifications for Electrical Installations in Small Houses which have been prepared by the Electrical Contractors' Association for the guidance of their members. These are meant to cover the requirements for houses not exceeding 1,500 sq ft floor area. These specifications should be of great assistance to contractors and to the client. I hope that these documents are used to the fullest extent and where possible shown to the client, in order that he is aware of what he is getting in his installation. I feel that this may be the answer to the cheap contractor who works to neither specification nor conscience. There are four documents in all, the first forms an introductory note, the second deals with t.r.s. systems and the other two deal with light gauge-welded conduit and heavy gauge-welded conduit systems.

## *Introductory Note*

The Introductory Note points out many matters which I have dealt with in the past. The first advice is given to the designer, and delights me, for it is a plea to discontinue the practice of siting the electricity service point and fuses, etc., "under the stairs." Not only is the siting of the gear in this position a source of inconvenience, but it adds to the cost of the installation. I have argued on this point many times and it now appears that we can expect a change. Consumers' units are recommended and, bearing in mind the neat appearance of these, this should do much to persuade the architect that the fusegear need not interfere with the internal decorations.

Fuseways for lighting and socket-outlets are sensibly dealt with and emphasis placed on the matter of adequate ways and the *very small cost* involved in allowing for these. An ample supply of sockets is also called for and the possibilities of accidents and fires due to "false economies" carefully pointed out. Switches of the type using two screws to secure the cover are recommended and the important matter of earthing is fully dealt with, and I commend the suggestion of two prices to cover the earthing of the installation. The documents rightly state that the time available for the submission of a tender does not normally permit tests to be carried out to determine the exact type of earthing desirable in the district. This suggestion is that two prices for this work be given: the first to cover normal earthing and the second to cover the provision of an e.l. trip or the driving of a separate earth electrode, whichever is most economical. The client then knows, when the tender is submitted, exactly what price he has to pay for the work.

The document covering t.r.s. systems details the requirements for the consumer's unit and goes on to detail the size of cables for lighting, sockets, cooker and immersion heater. It emphasises the rules which we know so well but are inclined to treat in a casual manner. We are reminded of the correct position to bore through joists when running cables at right angles to the joists. I particularly like the recommendation with regard to the cooker. This calls for the conduit protecting the t.r.s. cable to be run to a box position some 6 in. to the right or left of the cooker and from the box to another box sited 18 in. from the floor in the centre of the cooker. This avoids a long length of cable run on the surface to connect the cooker to the control switch.

The specifications for the two conduit systems are alike, except for the points dealing with the different methods of connecting the conduits to outlet boxes, etc. Again we are reminded of the many points which we are apt to treat lightly and, probably, a little carelessly. B.S. numbers and I.E.E. Regulations are mentioned and I feel that it is essential to get the man on the job interested in the B.S. numbers and so be able to explain to the client the benefit of dealing with material which is manufactured to the standards laid down.

I feel, however, that one matter has been missed. We must realise the possibilities of using m.i.c.c. cables for small houses and I am sorry to see no mention is made of this cable. I have already pointed out that this cable can compete with a b.e. enamel conduit system in price, and I therefore feel that some guidance on its installation should have been given by the E.C.A. Only recently I saw houses being erected by a public authority and being wired with m.i.c.c. cables at no more cost than a b.e. conduit system.

## *Aid to Fixing Ceiling Boxes*

Where circular metal junction boxes are used at lighting points and pull switch positions it is usual practice to install a wooden fixing batten. This is particularly essential for pull switch positions. Quite a bit of work is involved in this and time being an important factor these days, it is interesting to note that a manufacturer has studied this matter. I have just received a descriptive leaflet on this problem and this shows a bracket designed to speed up the erection and fitting of outlet boxes. The bracket is simplicity in itself and comprises a strip of metal bent at right angles with two fixing holes on one leg for fixing to the joist and on the other left two more holes with a cut-away section to go round the conduit. The two holes on the section which fits round the conduit are tapped 2 B.A. size and screws are supplied. The installer must drill the outlet box to allow the box to be fixed to the bracket. However, the brackets can be supplied already fixed to the appropriate box if desired, and the additional cost per dozen would probably show a saving against the time spent in drilling the boxes.

There is one one thing which strikes me with this type of fixing as far as lighting outlets are concerned. As the bracket must be fixed to the side of the joist the lighting point might be slightly off the required position. In some cases this may not matter too much, but where the point is required to be in the centre of the room, or in line with the centre of a window it may prove awkward. I consider this bracket to be the answer to fixing outlet boxes at pull switch positions.

# Wiring for Small Houses

## *Standard Specifications prepared by Electrical Contractors' Association*

WHEN small houses are wired, the electrical contractor commonly works to a sadly inadequate specification; often there is none at all. This has for long been a matter of concern to the better class of electrical contractor, for it gives wide scope at the "estimate" stage for the cheap-jack man to capture the contract with a scheme another would not willingly advance. As a contribution to the improvement of this unsatisfactory position, the Electrical Contractors' Association has now issued a set of standard specifications, suitable for use with houses whose floor area does not exceed 1,500 sq ft, for wiring in t.r.s. light-gauge conduit, and heavy-gauge screwed conduit.

The general principles behind the specifications are set out in introductory notes. At the beginning of these is a call to designers of houses to "break away from the practice of making provision for the electricity service point, meter, switchgear and fuses 'under the stairs'." The specifications recommend a metal-cased consumer's control unit, fixed as near as possible to the kitchen. At least two 30-amp fuseways for socket-outlets are called for in the specification, for houses over 1,000 sq ft floor area, the assumption being that ring circuits will be installed. Provision for two lighting circuits and for a cooker of up to 6 kW is required.

On the subject of socket-outlets, the introductory notes emphasise that any initial economy secured by installing only one socket-outlet in each room is outweighed by the expense that must be incurred later on "when inevitable unauthorised extensions to installations are made by consumers which may lead to accidents or fires." Two or more socket-outlets, at least in the main living room, are recommended, and there is a reminder about vacuum cleaner operation in halls and landings. In the specifications proper, the number of socket-outlets is indicated only by reference to the plan required to accompany the specification.

There is a suggestion in the notes, that when the house is handed over, fuses of different ratings to match the ratings of the various appliances should be available. If only 13-amp fuses are supplied, then a standard lamp, for instance, will be over-fused.

One 15-amp circuit (7/·029) for an immersion heater is provided in the specifications. The notes call attention to the desirability of properly lagging the tank, and of avoiding operation of the immersion heater long after it is needed. With the latter point in mind, the specifications call for a pilot lamp to be in the immersion-heater circuit at a convenient point.

Finally, the introductory notes deal with conduit and cable runs and earthing. Conduits and cables in roof spaces should be kept clear of areas where they may be trodden on. The practice of running cable or conduit diagonally across walls is deprecated, because of the difficulties of location thereby introduced.

The earthing clause of the specification calls for connection to the supply authority's earthing terminal, cable sheathing, or the cold water supply system. It is explained in the covering notes that a tender is normally based on the assumption that this can be done. However, if earthing in the locality is difficult, it may be desirable to fit an earth-leakage circuit-breaker or drive a series of earth electrodes. In either case an additional expense is incurred. Since there is usually insufficient time to make the necessary tests before tendering is required, provision is made for two prices to be quoted, one assuming no difficulty with earthing and the other, that a 60-amp d.p. earth-leakage circuit-breaker will have to be fitted. Thus, if special earthing precautions become necessary, the price is already known.

Detailed in the specifications are B.S. numbers of standard fittings where called for, methods of running and fixing conduit and cables, and tests before handing over.

It is understood that sets of these specifications have been sent to all local authorities throughout the country. A point to note is that all mention of the E.C.A. has been excluded, except from the introductory notes. Copies of the specifications, price 6d. each or 9d. per set (post free), are obtainable from the Electrical Contractors' Association, 14 Bedford Row, London, W.C.1.

## RADIO RESEARCH

THE Report of the Radio Research Board for the year 1954, continues to emphasise the work being carried out on the propagation of radio waves. This is a subject of increasing importance if the best possible use is to be made of the already crowded radio spectrum. The work on very low frequency propagation (in the region of 100 to 500 kc/s) has a considerable bearing on navigational aids, while work at the very high frequency end of the spectrum is mainly directed toward the improvement of radar and television facilities. Propagation in the decimetric wavelengths in the region 470-960 Mc/s will prove of great importance in this connection.

At University College, London, work is continuing on the investigation of phenomena associated with the transmission of radio waves along the surface of metal wires and sheets. Some of the experiments showed that there was no doubt at all about the reality of an axial cylindrical surface wave supported by a capacitive surface and having a phase velocity exceeding that of light.

Research has also continued on materials of special interest in the current development of radio techniques. This work is directed toward obtaining a better understanding of the factors in a material which determine its electrical characteristics. At the Radio Research Station, rectifying and amplifying components and also monocrystalline filaments of germanium have been investigated and from the results it appears that modern theories require extensive modification.

At Imperial College, London, ferro-magnetic materials are being studied, and a second research function is the development of a medium (termed an "artificial dielectric") with a refractive index which changes rapidly with frequency. Such a material could be applied, for example, to a radio transmitter for scanning at high speed with a radiated beam. These artificial dielectrics consist of arrays of conductors with spacings and dimensions comparable with the wavelengths used.

At the moment the Radio Research Laboratory is hampered in its work by being housed in temporary buildings in the grounds of the Admiralty Compass Establishment, Ditton Park. A new building is, however, under construction and should be available at the end of this year. The Report is available from H.M.S.O., price 2s. 6d.

## INDUSTRIAL MAINTENANCE

# CAPACITOR MOTOR PROBLEMS

### *Notes on Starting Capacitors and Windings*

**By W. VINT**

THE recent Data Sheet giving the values of capacitors for different makes of single-phase motors will undoubtedly be of use to repairers and maintenance men alike but there will be nevertheless numerous occasions where the capacitance required is doubtful, either because the motor is:

1. Without label.
2. With agent's and not manufacturer's label.
3. Of foreign manufacture.
4. Received with an incorrect capacitor fitted.
5. Without any marking or value on the capacitor.

Since a motor will operate, or try to operate on a wide range of capacitance it may be somewhat difficult to assess the correct value and before examining the problem in greater detail it would be as well to review the six basic types of capacitor motor. These are shown schematically in Fig. 1 *a*—*f*.

In (*a*) we have the simple capacitor-start motor using an electrolytic capacitor which is taken out of circuit by some automatic device, either mechanically or electrically operated. The permanent-capacitor motor shown in (*b*) uses a paper and not an electrolytic capacitor, of low microfarads in circuit all the time in series with the auxiliary winding. A combination of (*a*) and (*b*) is shown in (*c*), the capacitor-start-and-run motor, where the motor starts with the two capacitors in parallel, giving a high value of microfarads and runs with the electrolytic capacitor disconnected, i.e., on a lower microfarads. Note that a single contact switch is used. A similar arrangement is illustrated in (*d*) using a double contact, i.e., changeover switch, again leaving the electrolytic capacitor disconnected in the running position of the switch. Where two capacitors are used, as in the last example, they are frequently fixed on the top of the motor and the larger (mechanically) of the two is the running capacitor.

The method shown in (*e*) is usually confined to larger motors where the capacitors, and the control gear, are fixed remotely. The two paper capacitors are connected in parallel for starting and in series for running.

Lastly we have the swing connection in (*f*) which is similar to (*a*) except that the starting winding is connected to the mid-point of the running winding which, acting as an auto-transformer, reduces the potential in the starting winding and the capacitor in series with it to approximately half line volts. This motor, unless wound for dual voltage has only three leads emerging from it, these three leads being a distinguishing characteristic. Unfortunately, this distinction depends on a knowledge of the type of winding in the motor because in (*a*) for example, if the joint A is buried in the winding three leads will also emerge from this motor. The phrase "swing connected" really refers to the method of reversing this particular motor by swinging the lead X to the other line terminal.

### *Running and Starting Windings*

With these six types in mind we can continue by considering first of all a split phase motor without any starting capacitor. In this motor the bulk of the winding space is occupied by the running winding and the starting winding, quite small, is placed in the tops of the stator slots, i.e., on top of the main winding (see later). The relative proportions of the two windings are roughly 10—1 and the stator will appear similar to Fig. 2. By the side of this drawing appears the actual winding diagram for a Higgs 0·33 h.p. motor showing the actual disposition of the coils and the number of turns per coil. It is now apparent that not only is the starting winding small in bulk but the wire itself is of very small diameter, this small section being necessary to obtain the necessary resistance in the S winding to effect a lag in that circuit and give starting torque. Also, by reasons of its small s.w.g. the current rating of the starting winding may be extremely high, 10-16,000 amps/sq in., compared with 2,500–3,500 amps/sq in. in the running winding.

Now it is possible, in some cases, to add a capacitor in series with the S winding and so convert the motor to a capacitor start machine. This may not have been the makers intention but such an expedient *may* improve the starting performance of the motor. The choice of such a capacitor is by experiment, using an electrolytic capacitor rated for approximately full line working and its value may vary from 30–80 $\mu$F for a ¼–½ h.p. 230 V motor.

If we now examine a true capacitor-start motor (*a*) Fig. 1 using an electrolytic capacitor rated for full line volts we find

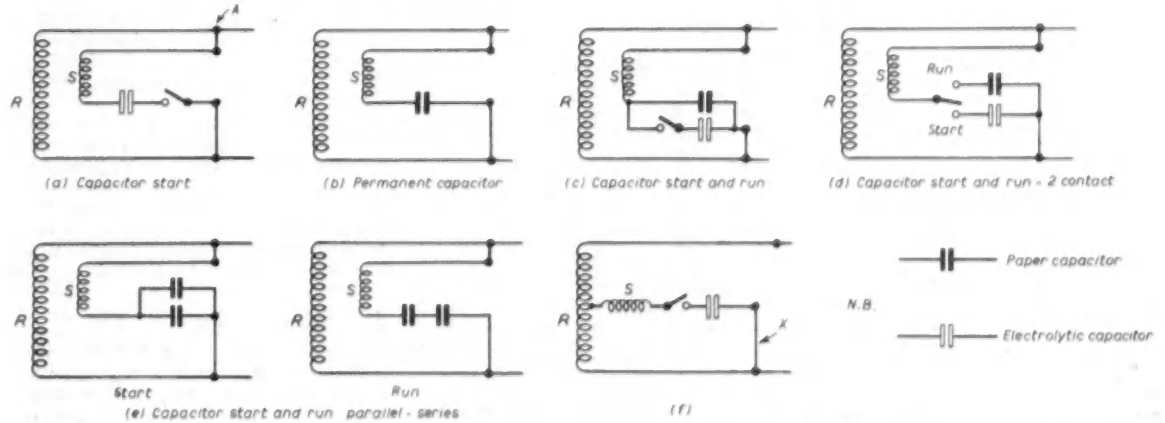



*Fig. 1. Six basic types of capacitor induction motor as described in this article*

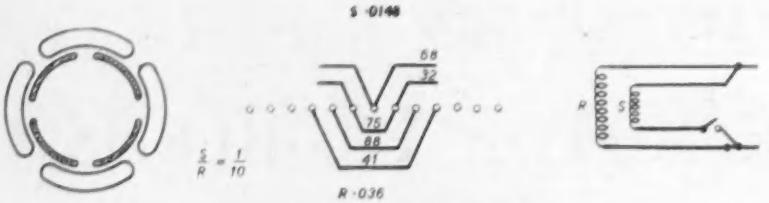



Fig. 2. Typical windings for split-phase motor (Higgs, ⅓ h.p.)

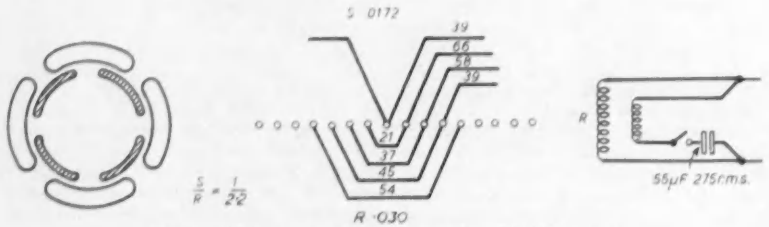



Fig. 3. Windings for capacitor-start motor (B.T.H., ¼ h.p.)

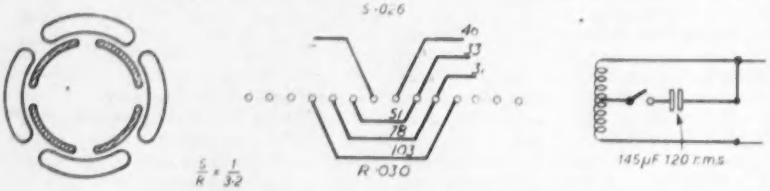



Fig. 4. Windings for swing-connected motor (Delco, ⅓ h.p.)

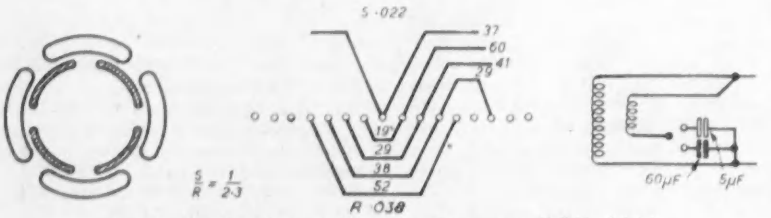



Fig. 5. Windings for capacitor-start-and-run motor (B.T.H., ½ h.p.)

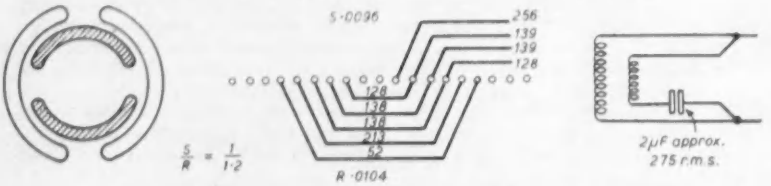



Fig. 6. Windings for permanent capacitor motor (B.T.H., 1/10 h.p.)

that the relative spaces occupied by the R and S windings are roughly 2·2—1 and an actual example is given of a BTH ¼ h.p. motor in Fig. 3. Not only has the bulk of the S winding increased but the gauge of wire has increased also, compared with the split-phase motor.

This is the circuit used for most f.h.p. motors and the common values for the capacitors are:

| | | |
|---|---|---|
| 1/6 | horsepower | 30–40μF |
| ¼ | " | 30–60μF |
| ⅓ | " | 40–90μF |
| ½ | " | 60–100μF |

Fig. 4 shows the swing connected motor, in this example a Delco 1/6 h.p. motor. Once again the ratio between the two sets of windings has altered and it is now approximately 3·2—1 and the size of the starting conductors begins to approach that of the main circuit.

We have already emphasised that this motor has only three leads and that it is easy to confuse it with the example shown in Fig. 1 (*a*) where the joint X converts a four-lead motor to, apparently, a three-lead one. As we have now shown the appearance of the two types of windings that could be confused, the following points should be noticed.

(*a*) The sizes of the running and starting conductors will be similar for the swing-connected motor.

(*b*) The swing-connected motor has a star joint where the S circuit taps on to the mid point of the main winding. In some motors, Delco particularly, this star joint is often quite easily found (usually diametrically opposite the circular or oval hole punched through the stator housing) and a little gentle probing will reveal the three wires, twisted and welded together and covered with a paper tube. On the other hand the so-called three lead motor with the joint X will only have two conductors joined together and made off to a flex lead which constitutes one line lead.

The true star point of the swing motor may, however, have more than three leads joined together. (See later for dual voltage and parallel windings).

The next type illustrated is the capacitor-start and capacitor-run machine, a B.T.H. ½ h.p. (Fig. 5). In this particular example the relation between the R and S windings is 2·3—1 and the starters are placed on top of the runners. Such a motor is often fitted to refrigerators and compressors, from ½ h.p. upwards.

It is not often realised that a capacitor-start machine can sometimes be converted to a capacitor-start-and-run motor by the addition of a suitable paper capacitor. The switching adopted in Fig. 1 (*c*), being that of the normal capacitor-start motor, will have to be used. The value of the added capacitor will have to be found by experiment and the current passed by it should not be greater than the carrying capacity of the starting windings, rating it at a maximum of 3,500 amps/sq in. This will necessitate measuring the starting wire but it is usually possible to tease up a single conductor high enough to measure it with a micrometer. Alternatively the omission of the running capacitor in the example under discussion will of course convert it to an ordinary capacitor-start motor, with a poorer performance.

The last example of winding is shown in Fig. 6, that of a B.T.H. 1/20 h.p. motor where the ratio between the R and S circuits is almost 1:1. While such windings are usually restricted to very small motors they are occasionally used in larger sizes up to 1 h.p. for special purposes. (See below).

Although the starting torque is much lower than of a capacitor-start motor they are used in considerable numbers in small fans, hair driers and in motors driving light mechanisms.

They have the advantage that no centrifugal or automatic switch is required, but the capacitor must be permanently rated, and in the very small motors this capacitor may be as large, mechanically, as the motor itself, a disadvantage if the motor has to be completely incorporated in a machine.

### *Difficulties in Determining the Windings*

So far the problem has been relatively simple but the wide variety of windings now in use can lead to considerable complications. Since the type of S

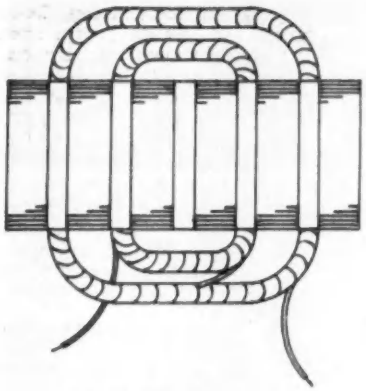


*Fig. 7. Concentric stator winding*

winding determines to a certain extent the value of the capacitor required, the first step in assessing this value will necessitate the location and examination of the S circuit or alternatively, determination of the main winding if that is the easier. This location may be difficult to decide because the relative positions of the main and starting windings vary, and while the common arrangement is to have the R winding inserted in the bottom of the slots, many makers will adopt the reverse order and have the runners inserted last to bring this set of windings nearer the rotor.

Examples of the normal arrangement, i.e., S on top, are to be found in f.h.p. motors made by: B.T.H., G.E.C., E.E., S.E.M., L.D.C., etc., and using the alternative arrangement: Delco (some models) Crompton Parkinson (some models) and especially so in larger motors made by Brooks and Hopkinson

The normal method of winding in all the above examples of f.h.p. motors is called the concentric winding, already illustrated in Fig. 2 and shown in Fig. 7 where the group of coils for each pole is easily recognised and the two sets of windings, being in two layers are equally visible. Moreover when the S winding is considerably smaller than the R winding, as in Fig. 2 its location is easy, but as the S and R windings become similar or equal in size so it becomes more difficult to say which is which—i.e., without the indications afforded by the connections of the coils to the automatic switch or to the main terminals as the case may be.

If, however, the motor has a distributed winding, Fig 8, the problem immediately becomes much more difficult because the winding, being in the form of a basket, with each coil occupying the same relative position in the stator, tends to conceal the polar distribution of the coil or groups of coils and because the two layers of the concentric wind are now merged together into one layer, with each coil covering and covered by its neighbour, the starting windings are no longer distinct. If such a winding has the coil taped all over with cotton it may be impossible, by inspection only, to say which coils are runners and which are starters.

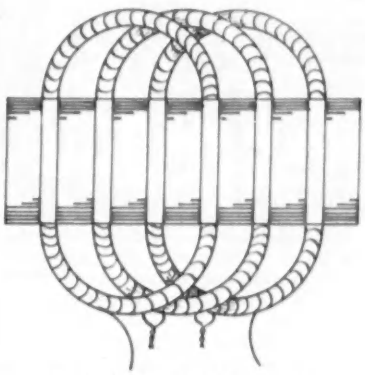


*Fig. 8. Distributed stator winding*

(To be concluded.)

# CABLES IN FACTORIES

CABLE runs in factories have received attention in two recent publications, previously reviewed in THE ELECTRICAL TIMES, where the emphasis has been on other applications. One of these is a new edition of the E.R.A. report on standard current ratings for paper-insulated and varnished-cambric-insulated cables up to 33 kV (Report Ref. FT/183, price 5s.), and the other a I.E.E. paper on the installation of cables in air.

### *Cables in Air*

That section of the E.R.A. report which deals with cables in air is based on single cables and on cables installed in pairs and in some cases in trefoil groups. Current ratings for lead-covered, paper-insulated cables are listed with appropriate factors for other types, at an ambient air temperature of 25° C (77° F). This temperature is defined as that existing without the presence of the cables. Rating factors are listed for variations in ambient air temperature above standard. For instance, for 1·1 kV cables, standard ratings are multiplied by 0·89 for 35° C ambient and by 0·77 for 45° C ambient. There is no increase in rating for ambient temperatures below 25° C. Ambient temperatures before cables are installed may be measured by thermometers in free air at the position to be occupied by the cables. After installation, to avoid influencing readings by heat rising from the cables, thermometers should be placed 1–2 ft distant from them horizontally or 6 ft below. Ambient temperatures exceeding the standard value only for a few hot days at midsummer may be ignored.

The tables assume certain conditions of installation which it is well to bear in mind when abbreviated versions are in use. For instance, in all cases where cables are fixed to a wall, a distance of 1 in. is assumed between the wall and the nearest cable. Where single-core cables are installed a distance between centres of twice the overall diameter of the cable is assumed, for cables up to 0·3 sq in., and of 3½ in. for cables above 0·4 sq in. All cables other than single-core are assumed to be installed singly, fixed to a vertical wall.

Cables outdoors are of course liable to heating by solar radiation. To avoid reduction of rating, it is recommended that such cases should be shielded from the direct rays of the sun without restriction of ventilation.

### *Grouping of Cables*

Grouping of cables may lead to mutual heating effects and to the need for a reduction of rating. However, for cables up to 0·1 sq in. conductor section it is recommended that no reduction in rating be applied if the cables are run with a clearance of at least three inches. If in such a case, there are more than three cables, then the grouped cables should be installed in a horizontal plane. For cables above 0·1 sq in. the limits are 6 in. separation, and installation in a horizontal plane is recommended if more than four cables are run.

It is noted in the report that owing to the wide variation of conditions of running single-core cables in parallel, it is impracticable to give current ratings for cables under such conditions. Users requiring current ratings of cables for specific cases are advised to refer to the Electrical Research Association for information.

A feature of the tables for cables laid direct in ground or in ducts is the provision of factors for the uprating of cables when they are operated on a cyclic loading of 8 hours on and 16 hours off. In general, however, it is stated that for cables installed in air these factors are not sufficiently in excess of unity to warrant any increase in rating. Rating factors in the form of curves are given, nevertheless, for one-hour overloads after prolonged operation at partial loads.

### *Cables on Hooks*

The I.E.E. paper was by Mr Holttum, of B.I.C.C., and it was summarised in our issue of 21 Apr. together with the discussion on it at a meeting of the I.E.E. It advances a theory suggesting greater distances than are usually used between cable supports, where the cables are hung on hooks. While the method is undoubtedly applicable to runs in factories, it seems that most cables in such conditions will not suffer any disadvantages from compliance with established practice (except greater cost of installation) if they are not subjected to heavy cyclic loading.

# *Load Currents for A.C. and D.C. Motors*

**DATA SHEET 17**

IN planning factory distribution schemes some account must obviously be taken of the motors to be connected. Considerations of efficiency and power factor make misleading a direct calculation based on the watts equivalent of the mechanical load in horse-power. The accompanying tables relate to representative motors of average power factor and efficiency. In all cases, current is listed in full-load amps per line.

Normally, of course, motors will not be operated continuously at full load. In making allowance for this, it must be borne in mind that because of changes with load of percentage efficiency and power factor, the current taken by the motor does not vary directly with the load. Curves are in general the best way of estimating current at partial loads, and useful information in this respect (as is in many others) is given in a booklet published by the British Thomson-Houston Co., Ltd., Rugby, under the title "Installation and Care of Electric Motors." For instance, with a typical 4-pole inductor motor having a no-load current of 35% of full-load current, the current at quarter load is 45% f.l. at half-load 59% f.l. and at three-quarters load 78% f.l.

We are indebted to the British Thomson-Houston Co., Ltd., for permission to reproduce these tables.

### Current For Single-Phase Motors

Full load current (amps) for repulsion-induction and capacitor motors of average power factor and efficiency

| H.P. | VOLTAGE | | |
|---|---|---|---|
| | 240 | 415 | 480 |
| 1/4 | 2·0* | — | — |
| 1/3 | 2·5* | — | — |
| 1/2 | 3·6* | — | — |
| 3/4 | 5·2* | — | — |
| 1 | 7·5* | 2·9 | 2·5 |
| 2 | 9·5 | 5·5 | 4·8 |
| 3 | 14 | 8·1 | 7·0 |
| 5 | 22·5 | 13 | 11·3 |
| 7½ | 33 | 19·1 | 16·5 |
| 10 | 43 | 24·9 | 21·5 |
| 15 | 62 | 36 | 31 |
| 20 | 80 | 46 | 40 |
| 25 | 98 | 57 | 49 |
| 30 | 116 | 67 | 58 |

*These figures are for motors of the capacitor-start type only.

### Current For Three-Phase A.C. Induction Motors

Amps/phase at full load

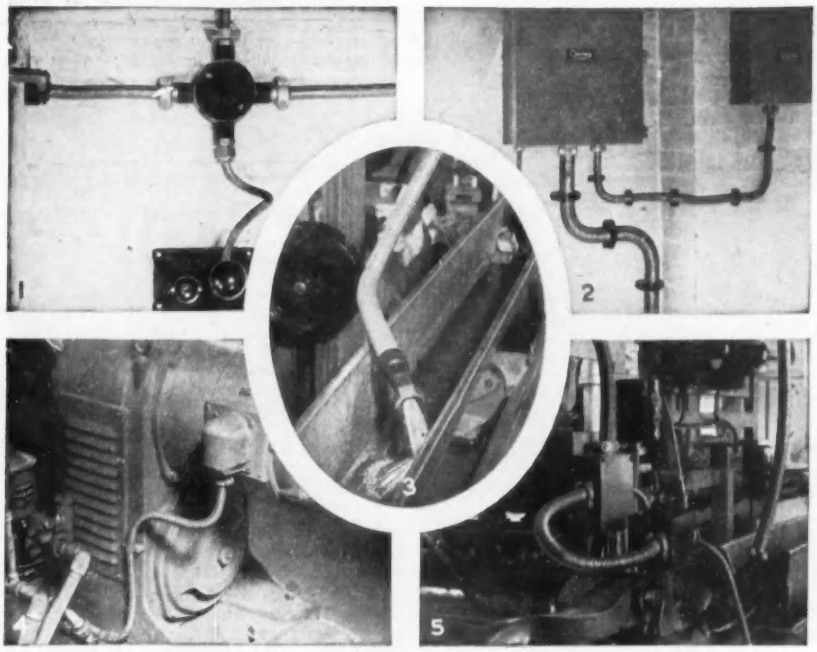
| H.P. | THREE-PHASE VOLTAGE | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 200 | 220 | 346 | 380 | 400 | 415 | 440 | 550 |
| 1 | 3·6 | 3·3 | 2·1 | 1·9 | 1·8 | 1·7 | 1·7 | 1·3 |
| 2 | 6·8 | 6·2 | 4·0 | 3·6 | 3·4 | 3·3 | 3·1 | 2·5 |
| 3 | 9·6 | 8·8 | 5·6 | 5·1 | 4·8 | 4·6 | 4·4 | 3·5 |
| 5 | 15·2 | 13·8 | 8·8 | 8·0 | 7·6 | 7·3 | 6·9 | 5·5 |
| 7½ | 22·0 | 20·0 | 12·7 | 11·5 | 11·0 | 10·6 | 10·0 | 8·0 |
| 10 | 28·6 | 26·0 | 16·5 | 15·0 | 14·3 | 13·8 | 13·0 | 10·4 |
| 15 | 42 | 38 | 25 | 22 | 21 | 20 | 19 | 16 |
| 20 | 56 | 51 | 33 | 29 | 28 | 27 | 26 | 21 |
| 25 | 70 | 64 | 41 | 37 | 35 | 34 | 32 | 26 |
| 30 | 82 | 75 | 48 | 43 | 41 | 39 | 38 | 30 |
| 40 | 112 | 102 | 65 | 59 | 56 | 54 | 51 | 41 |
| 50 | 138 | 126 | 89 | 73 | 69 | 66 | 63 | 50 |
| 60 | 166 | 151 | 96 | 87 | 83 | 80 | 75 | 60 |
| 70 | 194 | 176 | 112 | 102 | 97 | 93 | 88 | 70 |
| 80 | 222 | 202 | 128 | 117 | 111 | 107 | 101 | 81 |
| 100 | 276 | 256 | 160 | 145 | 138 | 133 | 126 | 100 |
| 125 | 344 | 312 | 199 | 181 | 172 | 166 | 156 | 125 |
| 150 | 412 | 374 | 238 | 217 | 206 | 199 | 187 | 150 |
| 200 | 548 | 498 | 317 | 288 | 274 | 264 | 249 | 199 |
| 250 | 670 | 610 | 387 | 353 | 335 | 323 | 305 | 244 |
| 300 | 800 | 728 | 462 | 420 | 400 | 385 | 363 | 291 |

The currents given apply to motors of not less than the following speeds: up to 10 h.p., 750 r.p.m.; 10 to 30 h.p., 600 r.p.m.; 30 to 125 h.p., 500 r.p.m.; 125 to 300 h.p., 375 r.p.m. For two-phase motors, multiply by 0·9. For mid-wire of two-phase three-wire, multiply two-phase current by 1·41.

### Current For D.C. Motors

Full load current for motors of average efficiency

| H.P. | VOLTAGE | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 100 | 110 | 200 | 220 | 230 | 240 | 250 | 400 | 420 | 440 | 460 | 480 | 500 | 530 | 550 | 600 |
| ½ | 6·2 | 5·7 | 3·1 | 2·8 | 2·7 | 2·6 | 2·5 | 1·5 | 1·4 | 1·4 | 1·3 | 1·3 | 1·2 | 1·1 | 1·1 | 1·0 |
| 1 | 11·0 | 10·0 | 5·5 | 5·0 | 4·8 | 4·6 | 4·4 | 2·8 | 2·6 | 2·5 | 2·4 | 2·3 | 2·2 | 2·0 | 2·0 | 1·8 |
| 2 | 20 | 18 | 9·9 | 9·0 | 8·6 | 8·3 | 7·9 | 4·9 | 4·7 | 4·5 | 4·3 | 4·1 | 4·0 | 3·7 | 3·6 | 3·3 |
| 3 | 29 | 26 | 14 | 13 | 12·0 | 12·0 | 11·0 | 7·2 | 6·9 | 6·5 | 6·2 | 6·0 | 5·7 | 5·4 | 5·2 | 4·8 |
| 5 | 46 | 42 | 23 | 21 | 20 | 19 | 18 | 12·0 | 11·0 | 10·0 | 9·6 | 9·4 | 9·2 | 8·7 | 8·4 | 7·7 |
| 7½ | 67 | 60 | 33 | 30 | 29 | 28 | 27 | 17 | 16 | 15·0 | 14·0 | 14·0 | 13·0 | 12·0 | 12·0 | 11·0 |
| 10 | 88 | 80 | 44 | 40 | 38 | 36 | 35 | 22 | 21 | 20 | 19 | 19 | 18 | 17 | 16 | 15 |
| 15 | 129 | 117 | 64 | 59 | 56 | 54 | 52 | 32 | 31 | 29 | 28 | 27 | 26 | 24 | 23 | 21 |
| 20 | 169 | 154 | 85 | 77 | 74 | 71 | 68 | 43 | 41 | 38 | 36 | 35 | 34 | 32 | 31 | 28 |
| 30 | 250 | 227 | 125 | 114 | 109 | 105 | 100 | 63 | 60 | 57 | 55 | 52 | 50 | 47 | 46 | 42 |
| 40 | 330 | 300 | 165 | 150 | 143 | 137 | 132 | 82 | 78 | 75 | 72 | 69 | 66 | 62 | 60 | 55 |
| 50 | 413 | 375 | 206 | 187 | 179 | 172 | 165 | 103 | 98 | 93 | 89 | 86 | 82 | 78 | 75 | 68 |
| 75 | 615 | 560 | 308 | 280 | 268 | 257 | 247 | 154 | 147 | 139 | 134 | 128 | 123 | 116 | 112 | 103 |
| 100 | 805 | 740 | 408 | 370 | 354 | 340 | 326 | 204 | 194 | 185 | 177 | 170 | 163 | 154 | 148 | 136 |
| 125 | — | — | 506 | 460 | 440 | 422 | 405 | 253 | 241 | 230 | 220 | 211 | 202 | 191 | 184 | 168 |
| 150 | — | — | 606 | 550 | 526 | 504 | 484 | 303 | 288 | 275 | 264 | 252 | 242 | 228 | 220 | 202 |
| 175 | — | — | — | — | — | — | — | 352 | 338 | 320 | 306 | 294 | 282 | 266 | 256 | 235 |
| 200 | — | — | — | — | — | — | — | 401 | 382 | 365 | 349 | 334 | 322 | 303 | 292 | 268 |

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# Explosive Atmospheres in Factories

## *Alternatives to Flameproofing for Electrical Equipment*

WHEN electrical equipment has to be used in an atmosphere that may become explosive due to leakage of gases or vapours, the first precaution that comes to mind is the use of flameproof gear. Yet this is by no means the only technique that may be used, nor is it necessarily the most suitable.

Over 30 gases and vapours have been listed by the B.S.I. in respect of their explosion characteristics: they are shown in Table 1. Where these gases, etc., may be present in factories, the governing requirement is generally Regulation 27 of the Electricity (Factories Act) Special Regulations, 1908 and 1944, which states that "all conductors and apparatus exposed to . . . . explosive atmosphere . . . . shall be so constructed or protected, and such special precautions shall be taken as may be necessary adequately to prevent danger in view of such exposure or use." There are for some applications and risks special regulations, but no regard is paid to these here.

Flameproofing has already been mentioned as the most obvious method of dealing with an explosive atmosphere. It has, however, certain limitations. The basis of flameproof construction is that it is impossible to make most items of electrical apparatus gas tight. As an alternative, a design is sought which will permit an explosion to take place inside the apparatus, should a spark ignite an explosive mixture of gas and air, without damage to the casing of the apparatus, and without transmission of flame, etc., such as will ignite an inflammable gas present in the surrounding atmosphere. As is well known, the solution is found in strong construction in which flanges are provided, in the case of methane, about 0·02 in. apart and of at least 1 in. width. This gap is long enough to cool any flame developed inside the apparatus, so that it cannot ignite an inflammable gas outside it. For testing purposes, gases are grouped as shown in Table 1, which is taken from B.S.229. Mining gear is certified normally for Group I, methane; the other groups which are more common in industrial processes, require special attention. This applies especially to the Group IV gases, which explode particularly violently when mixed with air. For these Group IV gases, called the "excluded" gases and vapours, the maximum safe gap at flanges, as determined by experiment, is too small to be practicable for most items of apparatus. Thus type tests cannot be used.

### *Flameproof Apparatus*

Flameproof apparatus is tested and certified by the Mines Department of the Ministry of Fuel and Power, but there is another class of apparatus which may satisfy the requirements of Regulation 27, and which is certificated directly by H.M. Chief Inspector of Factories. This is "approved" apparatus, and it is certified on a basis of construction as judged against use under specific conditions. In general, this in-between class of approved apparatus is restricted to the less sensitive gases.

### *Intrinsic Safety and Approval*

Next on the list of methods comes intrinsically safe circuits. The principle here is that any sparking that may occur during normal working will have insufficient energy behind it to be capable of igniting the gas or vapour for which the apparatus is certified. It is not possible to state a minimum current for each gas, everything depends on circuit characteristics, particularly inductance. It is obvious that intrinsic safety is a quality largely confined to low current equipment, and in fact small instruments, signalling and telephone equipment are usually concerned or, to an increasing extent, automatic control equipment.

In using intrinsically safe equipment, the principle on which the design is based needs to be kept in mind. This does not entirely obviate the risk that overheating may lead to an explosion, for instance, if a flexible in the circuit became reduced to one or two strands, and the current was then increased by a short circuit on some similar happening.

It has already been shown that for the purposes of flameproof certification, gases are placed in groups having similar characteristics. This is not attempted for instrinsic safety, except as regards (*a*) hydrogen, town's gas, coke oven gas and blue water gas, all of which are represented by hydrogen, and (*b*) pentane, hexane, heptane, acetone, carbon monoxide, benzene, butane, cyclo-hexene and cyclo-hexane, for all of which pentane serves. Petrol is recognised as a difficult case, but it was stated in 1953 that pending the completion of research work, apparatus certified for pentane will be tacitly accepted for the "petrol" risk.

### *Pressurisation and Segregation*

Of increasing application where flameproofing is not practicable in a hazardous area is the pressurised system, in which a positive pressure is maintained in the electrical equipment to ensure that any explosive gas or vapour in the ambient atmosphere keeps away from electrical equipment. A case has been quoted recently where this method was used in connection with flameproof-type lighting fittings where Group IV gases were present. Individual fittings were pressurised, the air supply being either through the electrical conduit or through an independent piping system feeding into the fittings. Air leakage could be a problem, for the cost of compression can mount up considerably, but leakage in such systems has been reported to be low.

The final method of dealing with explosive conditions is to mount the electrical gear outside them. Segregation in this way may occasionally be practised by placing motors outside potentially dangerous buildings. Another variation applicable in well-ventilated buildings is to place lighting fittings high in the roof, twenty or more feet above floor level, where heavy concentrations of gas are unlikely to collect.

The practice in Imperial Chemical Industries as regards hazardous areas was described in an I.E.E. paper by Mr D. B. Hogg, in 1950. Hazardous situations are divided into three classes, as follows:

B. Where inflammable or explosive gas, vapour, dust or volatile liquid, although processed, handled or stored in the area, is so well under conditions of control that its liability to constitute an explosion hazard, in contact with electrical apparatus, may be considered negligible.

TABLE 1. EXPLOSION CHARACTERISTICS OF INFLAMMABLE GASES AND VAPOURS.

| Gas or Vapour | Limits of Inflammability (per cent) |
|---|---|
| I. Methane | 5–15 |
| II. Blast furnace gas | 28–70 |
| Propane | 2–9·5 |
| Butane | 1·5–8·5 |
| Pentane | 1·5–7·5 |
| Hexane | 1–7 |
| Heptane | 1–6 |
| Iso-octane | 0·5–3·5 |
| Decane | 0·5–2·5 |
| Benzene | 2–8 |
| Xylene | 1–6 |
| Cyclo-hexane | 1–8·5 |
| Acetone | 3–13 |
| Ethylene | 2·5–35 |
| Methyl-ethylketone | 2–12 |
| Methyl acetate | 3–15·5 |
| Ethyl acetate | 2–11·5 |
| Propyl acetate | 1·5–8 |
| Butyl acetate | 1·5–15 |
| Amyl acetate | 1– |
| Methyl alcohol | 5·5–36·5 |
| Ethyl alcohol | 2·5–19 |
| Iso-butyl alcohol | 1–50 |
| Butyl alcohol | 1– |
| Amyl alcohol | 1– |
| Ethyl ether | 1·5–48 |
| III. Coal gas | 5·5–31 |
| IV. Acetylene | 2·5–82 |
| Carbon disulphide | 1–50 |
| Hydrogen | 4–74 |

*These figures are taken from BS 229:1946. The Grouping is that used in flameproof testing and certification.*

C. Where inflammable or explosive gas, vapour or volatile liquid is processed, handled or stored in the area under conditions of control such that its liability to constitute an explosion hazard in contact with electrical apparatus cannot be considered negligible and for which certified apparatus is available.

D. Where the above materials are continuously present in explosive concentrations, or for which no certified electrical apparatus is available.

In Class B areas, it was stated, the guiding principle with apparatus which may give rise to sparking or heating is that it should be so constructed as not to give rise to a hazard if temporarily surrounded by an explosive atmosphere. For Class C, all electrical apparatus installed in the area must be certified flameproof or intrinsically safe for the group to which the hazard belongs. In Class D areas, no electrical apparatus should be installed in the danger area. Lighting should be projected from outside the area. In effect, modern practice is to pressurise switch rooms and control rooms in Class C and D areas. In Class C areas the usual arrangement is to use non-flameproof motor-starters in a separate chamber free from hazard, and have a flameproof push-button station near the machine to be controlled. For Class D areas, motors are outside the area and drive through glands in a division wall.


**REFERENCES**

1. Memorandum by the Senior Electrical Inspector of Factories on the Electricity Regulations. 4th edn., 1951. H.M.S.O. (Factory Form 928).

2. B.S.229:1946 Flameproof Enclosure of Electrical Apparatus.

3. List of Certificates issued in respect of Intrinsically Safe and Approved Electrical Apparatus. H.M.S.O. (Factory Form 931).

4. A. G. Palmer and W. E. Harper, "The Lighting of Hazardous and Corrosive Locations in Industrial Plants." Illuminating Engineering Society. (See ELECTRICAL TIMES, 10 Feb., 1955.)

5. D. B. Hogg, "Some Notes on Electrical Installations in Large Chemical Factories." Proc. I.E.E. Vol 98, Apr., 1951, p. 125.


# *Insulated Conduit in Corrosive Conditions*

ELECTRO-CHEMICAL de-rusting is a metal cleaning process which has two principal advantages: it does not attack sound metal, and complete and intricate assemblies can often be processed without dismantling. As practised by the London firm Derustit Ltd., the essential feature is the immersion of the metal to be tested in a tank filled with an alkaline solution, and its connection as the cathode in relation to the tank walls. As the current passes, nascent hydrogen is liberated at the metal surfaces and reduces the iron oxide, i.e. the rust.

It is apparent, even from so brief a description of the process that it does not produce easy conditions for the necessary associated electrical equipment, and it is interesting to note that in a recent installation, the Eastern Electricity Board used Gilflex fume-proof fittings and junction boxes, and conduits. This addition to the established Gilflex range was introduced comparatively recently. It still has as its basis p.v.c. compound conduits, which are inherently resistant to corrosion. Water tightness is ensured by means of long threaded junctions between conduits and accessories, reinforced by a sealing compound. The standard accessories are phenolic mouldings; the conduits are self-threading into accessory spouts.

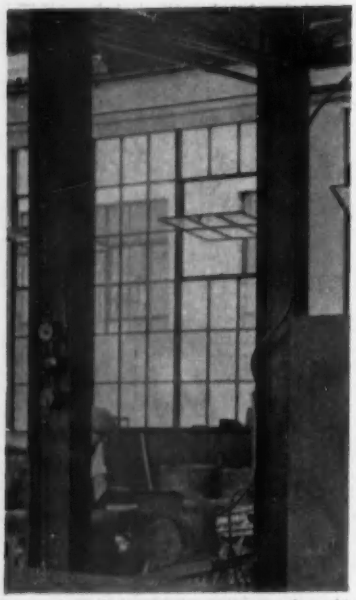


*Fig. 1. Installation was in progress when this photograph was taken. Controls shown are next to the "Derustit" vat*

### *Erection Practice*

When erecting Gilflex industrial conduit, a few precautions can ease the work and improve its finished appearance. Prior to erection, the conduit should be kept in a cool place. When being erected, the natural extrusion curve which the conduit exhibits should back on to the wall, so that the appearance of rise or sag between fixings is avoided.

The makers recommend the use of single-conductor p.v.c. insulated cables with the system. Drawing in such cables may be helped by the application of a little grease or oil as a lubricant, as both conduits and cables are impervious to attack by such materials. It is claimed that the conduits can be loaded to capacity, since because of their construction there is no fear of internal condensation.

It is important to remember that the provision of a separate earth continuity conductor is an essential corollary to the use of insulated conduits in an industrial installation. Bare stranded tinned copper or braided plain copper drawn in with the circuit wiring is usual.

An important feature of this system is the fact that the conduit entries into junction boxes, watertight switches, lighting fittings, etc., are maintained at one standard size. The conduits are so designed that the various sizes telescope into one another, so that for a small conduit to be taken into the standard size of outlet only a bushing by means of the next size of conduit is required. This obviously reduces the number of fittings that need be stocked.

There are several further instances of this system having been used successfully in fume-laden atmospheres. Examples are as diverse as a large chemical works installation in Birmingham, a bacon factory in Kent, and a sausage skin factory in London, whilst claims that the system is also proof against condensation have recently been confirmed by the Admiralty. Some years ago it was decided to investigate the possibilities of Gilflex conduits in this connection in a large block of flats in Singapore, and a report has recently been received to the effect that all claims made regarding this characteristic are fully substantiated.

*Fig. 2. This insulated conduit run passes almost directly over the vat*

Although it has been mentioned above that the joint between the conduit and the screwed box entry is sometimes reinforced by means of cement, this is mainly to increase the mechanical strength of the joint. Normally the threading in of the conduit forms a completely watertight and fume-proof joint, but where excessive vibration is likely to be encountered or the conduits and boxes may be exposed to weather or high winds, re-inforcement with cement is desirable.

# PROBLEMS AND PRACTICE

## In Engineering

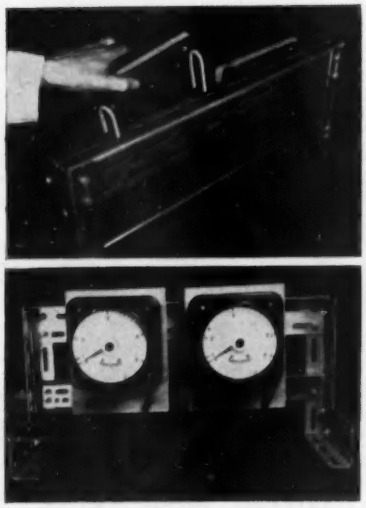
*Every engineer has a story to tell; why not tell yours on this page? We welcome contributions to this feature, and those published will be paid for at our standard rates. Problems which are encountered and overcome in day-to-day maintenance or installation of electrical plant; useful methods and techniques developed for specific jobs, or current practices, all make instructive reading for others. We will also consider for publication problems requiring an answer. Sketches are often helpful and need only be rough, as they will be redrawn before use.*

### Handy Dodges

REFERRING to H.M.'s tip on replacing small screws, I, having used this method a number of times, have found that another handy way is to lay a small piece of black tape over the blade of the screwdriver being used, and press the screw on, and it holds quite firm while it is being replaced. Another dodge I have found useful a number of times is when requiring a neat right angle bend in ¾ in. close joint conduit, to use a plumber's bending machine with the ½ in. former, and with the seam facing up it will make a neat bend which is also easy to wire.—*N. R. L.*

### "Portable" Instruments

TO facilitate the use of their switchboard instruments for bench work, the Electrical Engineering Dept. of Wandsworth Technical College have devised a handy method of mounting these instruments which is likely to be of value to other educational establishments. Each instrument has been mounted on a squared-up wooden plaque, connections being brought out from the rear to terminals mounted on the face of the plaque below the instrument. A further development is the fitting of two U-shaped hooks to the back of each mounting plaque to enable the instruments to be suspended from slotted angle framework specially erected for this purpose at the far side of each bench. Small blocks of wood fixed to the back of each mount act as spacers to maintain the instruments in a vertical plane when in use.



*Illustrating the pleasing appearance and usefulness of the plaque-mounted switchboard instruments, with the suspension method shown above*

This arrangement, it is understood from Mr A. T. Bardo, B.SC.(ENG.), A.M.I.E.E. (Head of Electrical Dept.) not only keeps bench tops free for other apparatus, but enables full value to be obtained from their 6 in. dial instruments. Of Crompton Parkinson make, the instruments employ a circular platform scale, which, being easily read, has led to their use for class demonstration purposes. To this end an easel-height slotted angle frame work has been constructed on which the instruments can be hung.

### Disintegrating Motor

REPORTS of pieces of metal "flying from the motor" indicated a serious state of affairs particularly as the 20 h.p., 4-pole squirrel cage motor had only been in service for a short time. The motor had a ribbed frame with blow-over ventilation from a fan mounted at the driving end.

The fan, which was of the fabricated type, had in fact almost broken up, many of the blades were cracked where they had been bent and spot welded to the sides of the fan. Two blades were missing and these were evidently the pieces of metal which had been described as "flying from the motor."

The drive from the motor was by spur gears which were old and worn, setting up terrific vibration and this vibration transmitted to the motor had undoubtedly broken up the fan. With the fitting of a new fan the gears were attended to and with the amount of vibration considerably reduced no further trouble was experienced.—*"Torque."*

### Sunday Static

REPORTS of shocks from switchgear, etc., as a rule, receive priority attention from most electricians. When called to investigate a complaint of this nature I promptly made my way to the offending equipment. This happened to be a remote control on a batching machine, used to some extent in textile works.

This control point had been recently installed, due care being taken to its earthing. When stopping the machine the operator complained of receiving hefty "kicks." Tests on insulation revealed nothing of a faulty nature.

Being Sunday the machine operator had come to work in his "walking out" clothes and heavy crepe soled shoes. The shoes, which normally would have safeguarded the operator from shock, gave a clue to this mystery.

Certain textiles are prone to building static during processing. This static had accumulated in the operator through contact with the dry material, the shoes preventing a gradual discharge. When stopping the machine, contact with the metal of the remote control unit gave the impression of an electrical fault being present. To prevent further discomfort the remote control was insulated, allowing the operator to proceed with more confidence. On week days, apparently, the leather soled shoes worn by the operator had allowed the static to pass unnoticed.—*R. W. B.*

### Two-Way Switches

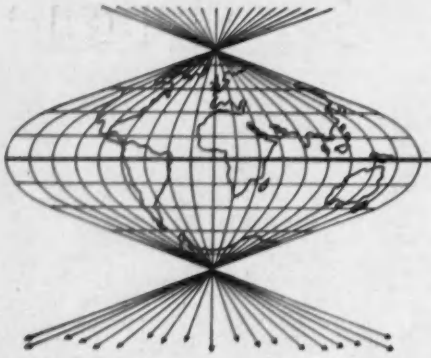
WITH regard to the recent correspondence on two-way switching, I wonder why it is that whenever it is necessary to replace a defective two-way switch, almost invariably the "common" terminal is in the wrong place in the new switch. This necessitates removing the block to drill a new hole, with consequent damage to decorations, and disturbing the dry wiring. I fail to see why two-way switches are not made with two pillar terminals on the "common" side instead of one pillar and one blind terminal. Either could then be used as suitable.

This would appear to simplify the manufacturing process, as one less component would be required. I have come across switches made with two pillar terminals, but these have always been of a cheap unbranded variety. This would appear to point to reduced manufacturing costs.

I have often made up a switch like this using a good pillar terminal from a defective switch, and if a few such switches were made up in the workshops, it would save considerable time.—*W. T. Wedlake.*

### Refrigerator Supply

A REFRIGERATION engineer has the idea of having a main switch with four fuses, instead of the usual two. He says that very often refrigerators are on the same circuit with other appliances, and when either the electric fire, toaster, iron, or kettle goes wrong, the user removes the appliance from the circuit and uses some other method of doing the job. But it is always the refrigerator that is missed, and with such an innovation the user could switch-over and get refrigeration without loss, taking an opportunity to replace the blown fuse during an off-cycle.—*B. Quarmby.*



# OVERSEAS NEWS

A SUMMARY OF IMPORTANT EVENTS

## CANADA

### Finance brings Expansion

Arrangements for new financing have been completed by the Maritime Electric Co. which owns and operates the electricity supply system in Charlottetown and Fredericton, and a number of towns and farms throughout Prince Edward Island. In 1954 it generated and purchased a total of 60·5 million kWh, against 37·3 millions in 1940. The new finance is intended primarily to refund outstanding mortgage bonds, but further expansion is contemplated, we gather.

### Bright Prospects in N.S.

Over 432 million units were sold by the Nova Scotia Power Commission during the year ended 30 Nov. last, an increase of 7·2%. Installed capacity now totals 133,622 h.p., but is to be increased shortly. Machinery for the new 6,000 h.p. hydro-electric project on the Mersey River is scheduled for delivery this spring, and the station is expected to be in commission during late summer. The Commission also expects to complete shortly a new 20,000 kW steam unit at Trenton. Shipment of equipment was held up last year due to the British dock strike, and as a result commissioning of the machine is being delayed 3 or 4 months beyond the original schedule.

### Beechwood Contract

The New Brunswick Electric Power Commission has placed a contract with the Dominion Engineering Co., of Montreal for two 45,000 h.p. turbines for the Beechwood hydro-electric scheme. Value of the contract is put at $950,000. The first machine is to be shipped to the site in April 1957, the second following a month later.

### Electrification Goal

Province-wide farm electrification for Manitoba, a project dreamed of in the early 1940s and started on a trial basis in 1945, became a reality for the Manitoba Power Commission with the end of its fiscal year at 31 Mar. Except for system reinforcement and scattered applications in areas not accessible to transmission lines, farm homes in Manitoba either have or can now have electrical power facilities. The Commission now supplies 103,000 consumers of which 42,000 are farms. This number will be increased by over 50,000 this year, if, as is expected, the City of Winnipeg takes over the power distribution facilities of Winnipeg Electric Co. in Winnipeg. In this event the Manitoba Power Commission will take over the distribution of power to present consumers of the Winnipeg Electric Co. in the suburban municipalities. The Commission's $6m programme for 1954-55 added 6,000 power users which included 2,500 farms. The others were in 14 towns and villages added to its system. The programme for the current year involves estimated expenditure of $5m.

## VENEZUELA

### Power Expansion

Orders have recently been placed for plant for Venezuela's new 75 MW thermal power station which is to be built at La Mariposa. The International General Electric, of America, is to supply the plant, which will consist of two units, the first of which is scheduled to be in operation by the end of 1957, and the second six months later. The station is intended initially to provide power for the four pumping stations of the River Tuy scheme. Present indications are that the Venezuelan authorities may not now proceed with the proposed steam power station at Carenero. There remain three other proposed power stations, under the Government's programme for which contracts have yet to be awarded. These are the Lobaterra (20 MW), Puerto Cabello (60 MW), and Puerto La Cruz (30 MW).

## NORWAY

### Oslo's Scheme

The municipality of Oslo has signed a loan contract with a group of Swiss banks, led by the Swiss Bank Corporation, Credit Suisse and the Union Bank of Switzerland, for a municipal loan of 25 million Swiss francs. Interest is at 4½% and the loan is to be repaid within 15 years in eight equal instalments annually, beginning 1963. The loan will be open to subscription in Switzerland at par from 24 May to 27 May. Under the contract, the Oslo municipality must order electrical material and equipment for the development of the town's electric power for a sum of at least 15 million Swiss francs, providing this can be done on a competitive basis, according to reports.

## S.W. ASIA

### Acquisition?

The Bijapur Municipality, Bombay, is considering a plan to start its own electricity undertaking when the licence of the Bijapur Electric Supply Co., Ltd., expires next year. It has been said that the financial position of the municipality is sound, and that a scheme to generate power at Butnal water works could be implemented without difficulty.

### Bombay Projects

Two hydro-electric projects designed to benefit Ahmednagar and Nasik districts are likely to be included in the next Five-Year Plan of Bombay State. The Randha-cum-Bhandardara project, located in the Akole taluka of Ahmednagar district, will cost Rs. 500 lakhs. The waters impounded by the Bhandardara dam across the Prawara River will be utilised for generating electricity. This project will supply power to sugar, cotton-ginning and power loom factories in 50 towns in the two districts. The other project involves the construction of two dams across the Adhala and Mahalungi Rivers near Sangamner town. Both the projects will be linked by transmission lines.

### Lead Supplies

The Hindustan Cable Factory, which went into production last Sept., will shortly start using indigenous antimonial lead, one of the principal raw materials of telephone cables. The cable factory has so far had to depend on imports of antimonial lead for its requirements. Indian products have so far failed to come up to the strict specifications, and as a result of concerted efforts suitable antimonial lead is now being produced in India. In the near future this source should meet all the cable company's requirements it is stated.

## SINGAPORE

### Domestic Development

Although considerable development in domestic electrification has taken place in Singapore in recent years, the city council is considering plans to launch an advertising and publicity campaign, as recommended by the city electrical engineer, Mr C. C. Payne. For some time now the undertaking has been in-

stalling considerable numbers of electric cookers and fans under its hire scheme. Current applications for cookers alone exceed 300 a month, and at the end of Jan. last there were 1,500 applications outstanding. So the department is hard put to it to meet the demand at the moment. But with a view to the future, the possibility of importing air conditioners is being investigated. For such appliances, Singapore could well be a very profitable market.

## AUSTRALIA

### N.S.W. Future Plans

In a power progress report to the Conference of Councils in N.S.W. earlier this month Mr H. G. Conde, chairman of the Electricity Commission of New South Wales, after referrng to the winter load in the state being estimated at well over 1,000 MW, said the existing programme of new generating equipment actually on order provides for the installation by the winter of 1960 of 750 MW. Much of this plant would be installed at the new stations of Tallawarra (already in part operation), and Lake Macquarie and Wallerawang (at both of which the first sets will be operating next year). For Tallawarra and Wallerawang 120 MW each have been ordered so far, while Lake Macquarie will have a capacity of 330 MV. These three stations will become the major base load stations in the southern, western and northern regions respectively. By 1962 a further 350 MW must be installed, the major components of which will be two 60 MW units for Wallerawang (for which tenders were recently called), and two 100 MW sets which it is proposed to install at Tallawarra. These latter sets will be the largest yet installed in Australia and will be similar to those being installed at Castle Donington and Willington in England. High pressure steam plant will be required. The Commission is also looking for a site for a further new station, which may provide another 600 MW by the winter of 1964. The Joint Coal Board has begun an intensive survey of N.S.W. coal resources suitably located for the generation of electric power. After referring to hydro-electric developments also in hand, including the Snowy mountains scheme, Mr Conde said the Commission had also ordered the first 70 mile section of a new line to operate at 330 kV to transmit power from the Tumut scheme of Sydney.

### Rationing for Tasmania?

The Tungatinah power station of the Hydro-Electric Commission of Tasmania is to be officially opened by the Governor-General, Sir William Slim, on 20 May. Meanwhile an extremely dry summer has reduced the State's water storage to little more than 30% of full capacity, and there is fear that power rationing may have to be reintroduced. That the State Government is watching the position closely and is ready to act is indicated by the statement by the Premier, Mr Cosgrove, a few days ago, that if the drought conditions were prolonged and made electricity rationing unavoidable, the Government would ensure that all industries would be placed on an equitable footing; no industry would receive preferential treatment. He said that the No. 2 Tarraleah canal, which has a capacity daily flow of 161 million gallons has now been placed in commission. Mr Cosgrove said the statement that the Tungatinah power station had to cease operation was incorrect. The station was constructed as a peak load station and not as an average power producer. It had never been closed except during repairs to the tunnel.

### H.E. Scheme

The Hydro-Electric Commission of Tasmania propose to build a power station on the Huon River capable of developing 45,000 h.p. Mr Dwyer, the Minister for Agriculture, in revealing this, said the 45,000 h.p. would be sufficient for the far southern districts, and would relieve the State's power system.

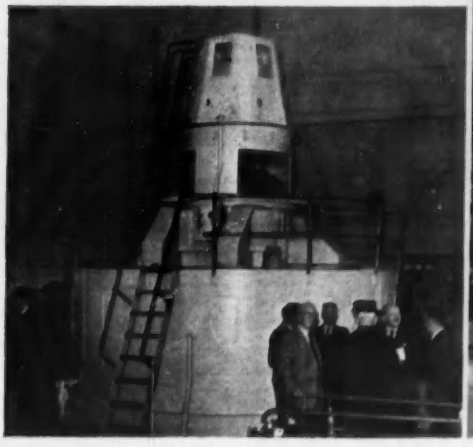
## NEW ZEALAND

### Geothermal Power

Workmen have started on the foundations of a building to house the first electric power unit in New Zealand to be powered by geothermal steam. A small plant which once produced power to drive the Christchurch trams will be installed at Wairakei within a few weeks by Ministry of Works engineers. Although originally of 500 kW capacity, it is expected that the plant will only produce just over 200 kW, which is more than enough for the power requirements at Wairakei at the moment. The machine will be supplied from a 1,500 ft deep drilling, and the steam will be dried through a separator before entering the turbine and discharged to atmosphere.

*To complete the chain of four power stations on the Waipori River, New Zealand, Dunedin City Council officially opened the Nos. 3 and 4 stations a few weeks ago. (No. 3 station had previously been operating for some months). No. 3 power station, shown below, left, has a Francis runner type turbine, operating on a gross head of 165·9 ft, driving a 6,400 kW alternator. The intake is situated about 4 chains down the river from No. 2 station, with a dam 35 ft high and 70 ft wide some 2 chains further down. From a lake 50 acres in area formed below No. 3 station, water is fed by steel pipeline to the No. 4 station which has a capacity of 7,200 kW and operates on a gross head of 185·9 ft. The external designs, and equipment are for the greater part similar in both stations, the turbines being by Boving and Co., with British Thomson-Houston alternators. The two stations, which are operated by Dunedin City Council Electricity Department, under the direction of the N.Z. State Hydro-Electric Department, are controlled from No. 2 station by the constant total impulse system. Incidentally, Mr G. T. Edgar, M.I.E.E., who has been city electrical engineer at Dunedin since 1938, retired from that position at 31 March. His successor is Mr A. H. Dickson*

*Dunedin's Waipori No. 3 station, right, and below, the interior of No. 4 station, at the opening ceremony, with Mr G. T. Edgar, formerly city electrical engineer, facing the camera in the foreground*



# Personalities

## IN THE INDUSTRY

The Minister of Fuel and Power has re-appointed the **Rt Hon Lord Citrine,** P.C., K.B.E., COMP.I.E.E., to serve as chairman of the Central Electricity Authority for another two years when his present term of office expires on 14 Aug. next, and has also re-appointed **Sir Henry Self,** K.C.B., K.C.M.G., K.B.E., to serve as deputy chairman of the Authority from the same date. Both Lord Citrine and Sir Henry Self have served as chairman and deputy chairman respectively since the Authority was first constituted in Aug., 1947.

Now in Britain on a business visit is **Mr F. C. Edmondson,** M.I.E.(AUST.), M.I.E.E., general manager of the State Electricity Commission of Western Australia. One of the purposes of his visit is to study the use of nuclear energy for power generation, we understand.

After over fifty years' service with the company, and ten years as chairman, **Mr H. W. Bosworth,** A.M.I.E.E., is to resign the chairmanship of Lancashire Dynamo Holdings Ltd. at the end of this year, he states. It is hoped that **Sir Percy Mills,** BT., K.B.E., the deputy chairman, will take over the chairmanship.

**Mr William Hamilton** has been appointed vice-chairman of the Hydro-Electric Power Commission of Ontario, in succession to **Mr George H. Challies,** who has been nominated as chairman of the Ontario-St. Lawrence Parks Commission.

The new president of the Association of Public Lighting Engineers, to succeed **Mr L. A. Doxey** in September, is **Mr J. M. Waldram,** B.SC., A.M.I.E.E., A.C.G.I., F.INST.P., F.I.E.S., senior research illuminating engineer, Research Laboratories of the General Electric Co., Ltd. He will be inducted into the office on 13 Sept. Educated at University College School and City and Guilds Engineering College, Mr Waldram joined the G.E.C. in 1923 after working on natural lighting in collaboration with his father Mr P. J. Waldram. He transferred to the Company's Research Laboratories in 1925 and ten years later was appointed to the leading scientific staff. He has specialised on street lighting, doing original work and publishing many papers on the subject, and is also author of a number of books on illumination.

District manager at Woking for the South Eastern Electricity Board since 1954, **Mr J. C. Poole,** A.M.I.E.E., has been appointed deputy engineer-in-chief to the Board, in succession to **Mr E. H. Skinner** who is now the Board's chief commercial officer. Mr Poole studied at the City and Guilds Technical College, and gained early training as a test hand with the British Thomson-Houston Co., Ltd. From 1920 to 1927 he was with the Electro-Technics Division of the National Physical Laboratory, and visited Australia in connection with research into refrigeration of fruit cargoes on ships. After three years as technical assistant with Callender's Cable Co. he joined the Surbiton electricity undertaking as assistant to the engineer and manager, and was later made district mains engineer. On nationalisation of the industry, Mr Poole became senior planning engineer for the Surrey sub-area and in 1954 was appointed Woking district manager. He is president of the district's sports and social club.

The new district manager at Woking for the South Eastern Electricity Board is **Mr E. Peel,** A.M.I.E.E., who has previously been district engineer there. A Lancastrian, Mr Peel will be the youngest of Seeboard's thirty district managers. He received his technical education at Blackburn Technical College and Regent St. London, Polytechnic, and started his career as a trainee with the electricity department of Blackburn Corporation. Before enlisting in the R.A.F. in 1940—he was commissioned in the electrical engineering branch—Mr Peel spent a year at Maidstone. On demobilisation in 1946 he was appointed as a mains assistant with Hammersmith Corporation and—under the London Electricity Board—became first assistant district engineer before joining Seeboard in 1954.

One of the founders of the Crypto Electrical Co., Ltd., **Mr J. G. Shaw,** is resigning from the board of Lancashire Dynamo Holdings Ltd. as from 1 June, but he is to continue to act as a director of two of the subsidiaries, Crypton Equipment Ltd., and Crypto Ltd.

Formerly with Electrical Components Ltd., **Mr W. Gardner** has been appointed manager of the Manchester branch of Drake and Gorham Wholesale Ltd.

A new Electronics Department just formed at Metropolitan-Vickers Electrical Co., Ltd., Trafford Park, Manchester, incorporates the former Radio Department, part of Marine and Special Contracts Department, and the service electronics section of Industrial Electronic Control Engineering Department. The industrial section of Industrial Electronic Control Engineering Department has been re-named Industrial Process Control Engineering Department. The following officials of the Electronics Department have been appointed: superintendent: **Mr E. T. W. Barnes,** A.M.I.E.(AUST.), A.M.I.PROD.E. (formerly superintendent, Radio Department); assistant superintendent: **Mr D. E. Thornhill,** B.SC.TECH., GRAD.I.E.E.; chief engineer: **Dr L. W. Brown,** B.SC., PH.D., M.I.E.E., F.INST.P., (formerly chief engineer, Radio Department; assistant chief engineer: **Mr T. R. Goode,** B.E., A.M.I.E.E. (who was formerly assistant chief engineer, Radio Department); assistant chief engineer (Special Applications): **Mr J. L. Russell,** A.M.I.E.E.; sales manager: **Mr L. H. J. Phillips** (formerly sales manager, Radio Department); and assistant sales manager: **Mr J. Nicholson** (formerly assistant manager, Marine and Special Contracts Depart-

*Mr J. M. Waldram*

*Mr J. C. Poole*

*Mr E. Peel*

*Mr D. E. Thornhill*

*Mr J. L. Russell*

ment). **Mr G. W. G. Canter,** formerly manager, Marine and Special Contracts Department, has been appointed manager, Special Contracts, and will be located in London. Mr D. E. Thornhill, who is assistant superintendent of the new department, joined M.-V. as a vacation apprentice in 1936. After technical education at the Manchester College of Technology and completion of trade and college apprenticeships, he became a junior engineer in Instrument and Meter Department in 1946. Two years later he transferred to M.-V.'s subsidiary company, Newton Victor Ltd., as development engineer at the Motherwell Works. Mr J. L. Russell, who is assistant chief engineer (Special Applications) of the new department, received his technical education at the Manchester College of Technology. After a trade apprenticeship at M.-V. from 1936 to 1940 and a period in the Plant Department Drawing Office he joined the Railway Signals Department as a junior engineer. In 1947 he moved to the Electronic Control Engineering Department, where he has been section leader, special contracts, since 1949.

**Mr Robert S. Stevenson** has been elected President of Allis-Chalmers, in succession to the late **Mr W. A. Roberts.**

At present deputy chief contracts officer at the London headquarters of the Central Electricity Authority, **Mr E. L. Gethin,** B.SC.(ENG.), A.M.I.E.E., D.F.H., M.P.O.A., has been appointed supplies and production adviser to the British Transport Commission. Taking up his new position on 13 June, Mr Gethin will be responsible for the proper utilisation of the Commission's very large industrial facilities and for the co-ordination of their purchasing programmes. The appointment is of special importance in view of the £1,200 millions programme for the modernisation and re-equipment of British Railways. Trained at Faraday House and London University, Mr Gethin served a 2-year college apprenticeship with Metropolitan-Vickers Electrical Co., and after a further year in the estimating section of the Motor Department, joined Edmundsons Electricity Corporation Ltd. in 1930. With that group of companies he became assistant purchasing agent in 1935, and in 1940, purchasing agent, being responsible for all capital purchases of the group. On nationalisation he became chief purchasing officer of the Southern Electricity Board, and on 1 July, 1948, was appointed specifications and contracts engineer at the B.E.A. headquarters. Upon the setting up of a separate Contracts Dept. in 1950 he was appointed to his present post.

*Mr D. N. Relf*

*Mr E. V. Small*

*Mr S. R. B. Brewer*

It is announced by the British Thomson-Houston Co. that **Mr D. N. Relf,** M.B.E., A.M.I.E.E., has been appointed assistant manager—Switchgear Contracts, Willesden. After a period at Kingston Technical School and afterwards at Acton Technical College, Mr Relf in 1930 entered upon an apprenticeship course at B.T.H. Willesden Works. On completion he entered the Drawing Office and in 1938 was transferred to the Engineering Department. From 1941 to 1946 Mr Relf served in the R.A.F., being commissioned as a pilot and attaining the rank of Flt./Lieut. For a period he was senior R.A.F. officer at Shaw Field, S. Carolina, U.S.A. On demobilisation, Mr Relf rejoined B.T.H. in the Switchgear Contracts Department, and in 1950 assumed executive responsibility for the Export Section of that department. In this capacity he has travelled overseas on the company's behalf.

**Mr Frank Rostron,** M.B.E., M.I.E.E., export sales manager, of Ferranti Ltd., has been elected vice-president of the Manchester Chamber of Commerce. He has been chairman of the Engineering and Metals Section.

Formerly field sales manager, **Mr R. T. Griffiths** has been appointed home sales manager of Hoover Ltd. After a career in the Royal Air Force, both in peace and in war, Mr Griffiths joined Hoover Ltd., as a sales-service representative, and quickly won promotion through the various grades in the sales force, becoming a district manager in 1946. In 1947 he was made northern branch manager, in 1948 sales personnel manager, and has been field sales manager, since Aug. 1953.

Managing director of the B.T.H. Export Co., Ltd., **Mr E. V. Small,** has been elected a director of the British Thomson-Houston Co., Ltd. Mr Small, after military service in the First World War, entered upon a student apprenticeship at B.T.H. Rugby Works, and in 1920 was awarded a "Fellowship" that took him to U.S.A. for a one-year study of American design and shop practice. On his return in 1921, he joined the staff of the B.T.H. Export Department and between 1923 and 1947 served the company in India, being managing director of Associated Electrical Industries (India) Ltd. from 1935 to 1947. Mr Small returned to England in 1947 on being appointed director and general manager of the B.T.H. Export Co. and in 1949 was appointed managing director of that company.

**Mr S. R. B. Brewer,** B.SC., A.M.I.E.E., who has for many years occupied senior engineering positions with Bryce Electric Construction Co., Ltd., has been appointed sales manager of the company.

Following upon the resignation of **Mr J. R. Ferguson** from the Crompton Parkinson Ltd. associate company, Cooke and Ferguson Ltd., the appointment is announced of **Mr A. F. Kistner** as general manager of the Cooke and Ferguson Switchgear Works in Manchester. Mr Kistner's service with Crompton Parkinson Ltd. dates back to 1927 when he commenced his apprenticeship training at the company's Chelmsford works. In 1933 he was appointed sales engineer in the Plant Division, and two years later took up duties with the company's agents in Hong Kong. His experience with overseas business was continued in 1937 when he joined the company's agents in Bombay. For the year prior to the outbreak of hostilities in 1939, he returned to this country as a plant sales engineer at the C.P. Manchester office. During the war years he served as Lt.-Col. with the Royal Corps of Signals and on the cessation of hostilities rejoined the company, subsequently taking up duties on the staff of the works director. In 1950, he was elected a member of the Crompton Parkinson Ltd Junior Board.

*Mr E. L. Gethin*

*Mr R. T. Griffiths*

*Mr A. F. Kistner*

The many friends of **Mr O. A. Sherrard,** former solicitor and secretary of the Central Electricity Board, will be interested to hear that his second volume of the life of the elder William Pitt, that colourful English statesman, is shortly to be published by John Lane, The Bodley Head Ltd. This volume, entitled *Lord Chatham,* covers the years 1755 to 1761; a third volume will follow to complete an absorbing life story.

To mark his 35 years' service in the electricity supply industry, **Mr D. M. Duncan,** district consumers' engineer, Loughborough district, East Midlands Electricity Board, was recently presented with a canteen of cutlery by **Mr D. C. Whyte,** district manager.

Appointed as station chemist at Carrington power station, is **Mr S. Barker.** We also understand that **Mr J. McLaughlan,** who is shift charge engineer at Doncaster power station, is to take up a similar post at Carrington.

Retiring after 50 years' service with the Bournemouth electricity undertaking, **Mr C. E. White,** A.M.I.E.E., sub-area meter engineer with the Southern Electricity Board, was recently presented with a gift of his own choice—a combined electric saw and drill—subscribed for by his friends and colleagues. The presentation was made by **Mr N. F. Gadson,** M.C., sub-area manager.

The appointment of two new directors of Kenwood Manufacturing Co., Ltd., is announced. They are **Mr J. Lecker** (a director of A. Hurst and Co., the company's export managers), and **Mr C. Sidebothom** (managing director of Wholesale Supplies (Swinton)). **Mr O. S. Ruane,** chairman, and **Mr R. C. Cox** have left the board, it is stated.

The State Electricity Commission of Victoria, Australia, has appointed **Mr R. G. Minchinton,** A.M.I.E.(AUST.), as distribution engineer, Metropolitan branch of the Electricity Supply Dept.

The British Transport Commission announce that **Mr E. G. Brentnall,** M.ENG., M.I.E.E., formerly assistant signal engineer, London Midland Region, at Euston, has been appointed assistant signal engineering officer in the Chief Signal Engineering Officer's Department.

In recognition of his 65 years service with William McGeoch and Co., Ltd., **Mr H. Jinks,** who is 85, last week received a presentation from the Lord Mayor of Birmingham, Ald J. R. Balmer, on behalf of the firm's directors. Our photograph on the right, was taken at the presentation ceremony. On the left of the picture is Mr W. Percy McGeoch, the works managing director, and in the background, Mr I. MacQueen, production manager.

*Mr Jinks receives the presentation from the Lord Mayor*

At the annual General Meeting of the Illuminating Engineering Society last week, the president, **Mr E. C. Lennox,** announced the names of officers and new members of Council to take office in October as follows: President: **Mr A. G. Higgins** (assistant secretary, Institution of Gas Engineers); Vice-Presidents: **Mr G. E. L. Comrie** (Holophane, Ltd.); **Mr J. W. Howell** (Lighting Service Bureau, Leeds); **Mr A. G. Penny** (General Electric Co., Ltd.); **Mr R. W. Steel** (South Western Electricity Board); and **Dr J. W. Strange** (Thorn Electrical Industries Ltd.). The Hon. Treasurer is **Mr E. B. Sawyer** (Lighting Service Bureau); Hon. Secretary: **Mr J. G. Holmes** (Holophane, Ltd.) and Hon. Editor of Transactions: **Mr C. R. Bicknell.** New Members of Council are: **Mr C. R. Bicknell** (Siemens Electric Lamps and Supplies Ltd.); **Mr H. Carpenter** (Blackpool Corporation); **Dr H. F. Gillbe** (Ministry of Transport); **Mr W. E. Rawson-Bottom** (Ministry of Works); **Mr John Reid** (Architect); **Mr N. C. Slater** (W. J. Furse and Co., Ltd.); **Mr W. J. P. Watson** (Holophane Ltd.); and **Mr A. H. Young** (Troughton and Young Ltd.).

**Mr Daniel Meinertzhagen,** a managing director of Lazard Bros. and Co., Ltd., has been appointed a director of W. T. Henley's Telegraph Works Co., Ltd., to fill the vacancy which will be created by the retirement of **Sir Montague Hughman** at the annual general meeting to be held on 3 June.

Two new part-time members of the East Midlands Electricity Board have been nominated. They are **Ald B. H. Gardner,** who has been a member of the area Consultative Council since 1950, and **Mr J. Stanier,** chairman of the Rennishaw Iron Co., Ltd.

**Lord Citrine** last week received an honorary degree of Doctor of Laws of Manchester University at the degree congregation held in commemoration of Founders' Day.

Metal Industries Ltd. announce the appointment to the board of **Mr J. O. Knowles,** chairman and joint managing director of Brookhirst Switchgear Ltd.; **Mr J. T. Rymer,** managing director of Sentinel (Shrewsbury) Ltd., and **Sir Charles Westlake,** at present chairman, Uganda Electricity Board. Mr Knowles and Mr Rymer will maintain their particular connections with their member companies of the group. **Mr R. W. McCrone** retires from the board after 33 years as managing director and latterly as chairman in order to devote himself more freely to other interests. The directors will recommend the appointment of Mr McCrone as one of the honorary presidents of the company. **Mr J. S. Hutchinson** is to succeed Mr McCrone as chairman. We have already noted that Sir Charles Westlake intends to relinquish his chairmanship of the Uganda Electricity Board later this year.

**Mr J. Fletcher,** installations superintendent of the Leeds Corporation Street Lighting Department, is to retire on 10 June after 51 years' service.

**Mr H. L. Trebilcock,** a director of the Plymouth electrical concern of Arthur Brand, was a successful candidate in the Plymouth City Council elections last week.

**Mr G. E. Wallichs** has been elected a director of Electric and Musical Industries Ltd.

**Sir Patrick Hamilton,** BART., has been appointed vice-chairman of the Expanded Metal Co., Ltd. He is the son of the late Sir George Hamilton who was chairman until his death in 1947, and a cousin of the present chairman, Lt.-Commander G. C. Hans Hamilton.

From Johnson and Phillips Ltd. we learn that **Mr W. S. Penn,** B.SC., has joined them as chief rubber technologist, and **Mr V. Rodman** will assist him as rubber cable chemist. In addition, **Mr H. J. Wigner,** A.M.I.E.E., has rejoined them as senior sales engineer. We hope to give more details next week.

## OBITUARY

**Mr E. W. Parsons,** who died recently aged 72, was associated with the formation of the Teignmouth Electric Lighting Co., Ltd., and on the absorption of the company by Whitehall Electric Investments Ltd., was made a local director, a position he held until nationalisation.

**Mr E. P. Allam,** founder and director of the London engineering firm of that name, died on 8 May, aged 86.

**Mr G. T. Webster,** who represented the Atlas Lighting Division of Thorn Electrical Industries Ltd., in Hampshire, for the past ten years, has died.

**Mr L. Paine,** first officer of the Central Electricity Authorities' freighter, *Sir Archibald Page,* died on 14 May, after being badly burned in a fire which broke out in the vessel while she was at Antwerp.

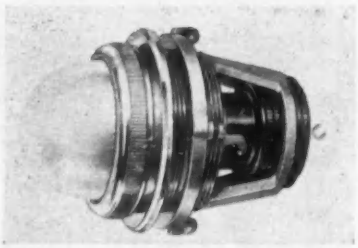
**Mr R. Garmany,** who was the representative in Ireland for a number of British electrical manufacturers, has died, aged 68.

**Mr A. T. Best,** formerly consultant with Rendel, Palmer and Tritton, consulting engineers, died on 16 May, aged 77.

# Equipment for Industry

## Compact Indicating Panel Light

IN the latest range of panel lights manufactured by WILLIAM MCGEOCH AND CO., LTD., Bordesley, Birmingham 10, one of the main features is the porcelain inside of the lampholder. This is designed to permit easy wiring from the back and also makes units suitable for tropical service. In type 7670, illustrated, a further feature is the size of the front glass which is 1¼ in. in diameter, and yet by virtue of the compact design of the clamp ring, mounting at 2¼ in. centres is possible. Although as standard, lamps are suitable for mounting on panels up to ¼ in. thick, a special clamp ring available, permits their mounting on panels having thicknesses up to 1½ in.



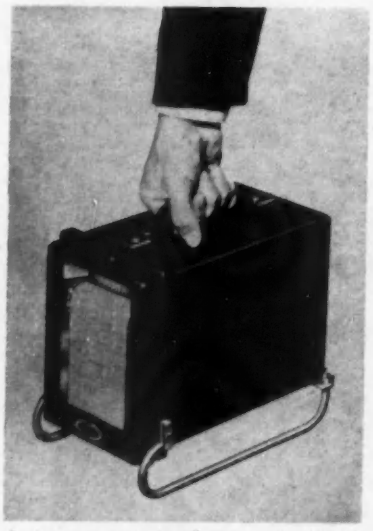
*Although having a glass diameter of 1¼ in., these lamps may be mounted at 2¼ in. centres*

## Universal Portable Recorder

EXCEPTIONAL sensitivity, high torque and low consumption are claimed for the latest pattern portable graphic recorder manufactured by the RECORD ELECTRICAL CO., LTD., Broadheath, Altrincham, Cheshire. This instrument, designed for use in conjunction with a clip-on current transformer, is most suitable for checking the current taken by motors or flowing through feeders, its main feature being that no disconnection of the main cables is required.

The recorder consists of a sheet steel case which houses an 8-day spring clock mechanism driving the chart and an electrical movement. The clock may be replaced by a synchronous motor where required. Speeds of 1 to 6 in. hr are standard for the chart which is 3 in. wide and has a length of 65 ft.

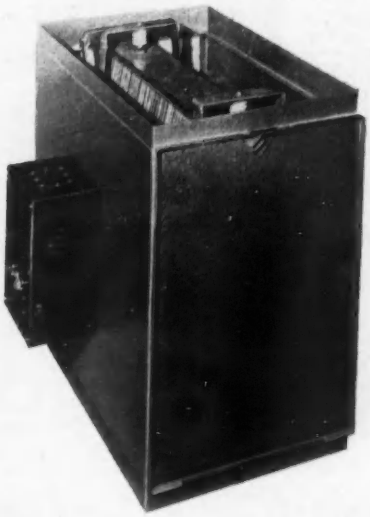
The use of a clip-on type current transformer is said to be possible due to the low consumption of the movement fitted to the recording instrument. This operates on the moving coil principle and requires only 1 mA for full-scale deflection. By moving a selector switch on the current transformer, a choice of 7 current ranges from 6/600 A is possible, and when the instrument is required to measure voltages a change-over link on the recorder provides selection of 3 ranges from 150/600 V a.c. The resistance of these ranges is 1,000 ohms/V.



*A clip-on current transformer used with this instrument permits current readings to be recorded on cables up to 2½ in. diameter*

## Small Plant Provides Clean Air

AN electrostatic precipitator which is of a size suitable for installation in small toolrooms, hospital operating theatres, hotels and other places where the presence of dust is undesirable, has been introduced by AIR CONTROL INSTALLATIONS LTD., Ruislip, Middlesex. This equipment, the "Electro-Klean," is claimed to be economical and efficient in operation, easy to install and is said to require little maintenance. It comprises a sheet steel case containing one or more filter elements, according to the application, and having an electronic power pack mounted on the side and is intended to be installed in an existing ducting system. The electronic unit provides the high voltage required for filtration and is designed to give 500 microamps at 11·5 to 12 kV. The output is derived from an r.f. oscillator which operates at a frequency of between 80-100 kc/s.



*This electrostatic precipitator is suitable for use in small installations such as toolrooms*

The filter elements consist of 28 sq ft of bonded woollen material arranged in concertina fashion within a rectangular fibre housing. The edges of the folds are coated with a metallic paint and have shorting bars running horizontally across the top and bottom edges. This arrangement ensures uniform distribution of the electrostatic charge over the entire filter when potential is applied to the shorting bars.

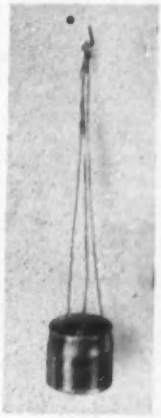
It is estimated that in normal atmospheres the filters will last approximately four months before requiring replacement. An exchange service is in operation for both these and the power packs should any trouble be experienced.

## Transistors for Digital Computors

FOR use in pulse circuits, a new high frequency point contact transistor, type EW51, manufactured by GENERAL ELECTRIC CO., LTD., Magnet Hse, Kingsway, W.C.2, is said to be of particular value in the field of digital computors.

One of the main features of these units, is the low value of inter electrode capacitance which is of the order of 1-2 pF. This has been achieved by reducing the distance between the point contacts on the germanium surface to approximately 0·001 in. Attention to mechanical construction has resulted in considerable shock and vibration resistance and storing in temperatures up to 70° C is said to have no effect on the characteristics of the units.

Housed in metal cases measuring only ¼ in. diameter by ½ in. long, the transistors are hermetically sealed and have withstood cyclic tests in high humidity and temperature conditions, over a period of 84 days proving their reliability in tropical atmospheres.



*These transistors are suitable for use in pulse circuits*

# For the Electrical Trade

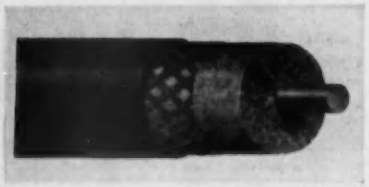
## Blaco Conduit Accessories

DUE to wage and raw material increases F. C. BLACKWELL AND CO., LTD., Great Crosby Works, Liverpool 23, have found it necessary to increase all the prices to be found in List No. 13, Mar., 1955, by 2½%.

Information also to hand describes the steel angle bracket for securing "Blaco" circular junction boxes to ceiling joists. These eliminate the use of wooden battens between the joists giving greater strength and saving time in erection. The bracket is secured to the joists by means of two wood screws and affords a means of fixing the box at the correct height to allow for the varying thicknesses of ceiling materials. It is available as a bracket to convert existing boxes complete with 2 BA screws at 5s. per dozen or as bracket and junction box with standard outlet, back or side entry, as ordered, assembled. Price as for approximate boxes listed in catalogue plus 7s. per dozen.

## TV Downlead Cables

THE new range of television downlead cables incorporating cellular polythene insulation which was recently introduced by BRITISH INSULATED CALLENDERS CABLES LTD., 21 Bloomsbury St, W.C.1, has been developed as an answer to the problem of the increased cable attenuation which occurs at the higher frequencies at which commercial television will be operating. Attenuation is approximately doubled in the change from 50 mc/s to 200 mc/s, but in general this loss of signal strength can be reduced by increasing cable dimensions or by the use of alternative materials as the dielectric. Research has shown that cellular polythene provides a most effective and practical alternative since it has a much lower dielectric constant than solid polythene despite the comparable dielectric loss and insulation resistance. These attentuation values are comparable with those of semi-airspaced cables without their inherent susceptibility to the ingress of moisture.

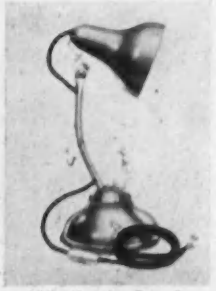


*BICC's new TV cable is designed to overcome attenuation in high frequencies*

## Berry's "Adjustalamp"

MOST attractive and efficient fitting just released by BERRY'S ELECTRIC LTD., Touchbutton Hse, Newman St, W.1, is the "Adjustalamp."

By means of a spring-loaded ball fitting in the weighted base and special reflector attachment, the lamp is infinitely variable in position. The reflector in contemporary styling gives concentrated light without glare and without interfering with the general lighting of the room, an important consideration in televiewing. The "Adjustalamp" is fully earthed. It is mounted on four rubber feet, stands 16 in. high and is available in contemporary red, yellow, black or gold finishes. Complete in strong carton with 6 ft of 3-core flex and switch, the fitting costs £2. 15s. plus 9s. 2d. p. tax.



*New line by Berry's*

## Two-Way Window Fan

REVOLUTIONARY design in window fans has been introduced by COLT VENTILATION LTD., Surbiton, Surrey, with their new two-way fan which acts as both exhaust and intake fan at one and the same time.

The fan and motor is supported on a horizontal plate both fan and plate being on the opposite plane to the window surface. The horizontal mounting plate ensures that the exhaust air stream at the top of the fan does not combat or interfere with the intake air stream at the bottom of the fan. The whole unit is then enclosed in a metal sphere with four diagonally opposite air ports which assist the movement of the air streams. Air enters the top left port (see photo) and is exhausted to outside through the top right port on the outside of the window. At the same time clean air is drawn in through the exterior bottom left port (not seen in photo) and enters the room through the lower right interior port.

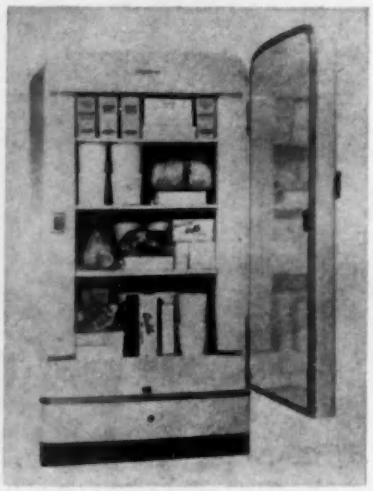
Tests carried out show that the performance of this new fan affords a nett effective air change of 4,140 cu ft of air per hour, after all allowances have been made for recirculation within the unit. Fixing and installation is simple. The unit has a single-phase B.T-H 200/250 motor rated 25/26 W. It is finished in polychromatic old gold enamel, has two closing shutter plates and can be fitted with filters as required (21s. 6d. per box of six). Price of the fan is £19. 10s. and delivery from stock is expected at the end of this month.

*Colt Ventilation have introduced this unique two-way fan*

## Coldrator Introduce Home Freezer

NEW home freezer to be known as the Model VF54 is announced by Coldrator division of the HOTPOINT ELECTRIC APPLIANCE CO., LTD., Peterborough.

The freezer is of the vertical type and has been specially designed as a twin to the Coldrator CS71 domestic refrigerator. It uses the same cabinet outer shell and door thus apart from the word "Freezer" it is externally identical. Food storage compartment has a "hammered" aluminium sheet interior lacquered in pale blue. Capacity is 5·4 cu ft whilst the three refrigerated shelves finished in corrosion resistant white enamel afford shelf area of 7·8 cu ft. The shelves, incidentally, have a plastic trim on front edge upon which pencilled notes may be made indicating shelf contents. Cabinet temperature is thermostatically controlled to permit a maximum temperature of 0° F and an audible alarm is fitted which indi-



*The Coldrator Home Freezer is companion to the CS71 refrigerator*

cates a rise in cabinet temperature beyond safe storage limit. A push button on the cabinet plinth enables the alarm to be cut off after it has been observed although it resets automatically. Hermetically sealed compressor is a spring mounted unit and the price 132 guineas, tax paid.

### Lighting Prices Reduced

NOTICE of price reductions in lighting equipment has been received from three A.E.I. companies, who have all announced changes relating to their fluorescent batten lighting fittings.

METROPOLITAN-VICKERS ELECTRICAL CO. LTD., 1-3 St. Pauls Churchyard, E.C.4, have with effect from Monday 16 May, reduced the price of their 5 ft 80 W (3794) and 4 ft 40 W (3814) streamlined ballen fluorescent fittings with "switch start" control gear to £5. 15s. 8d. and £5. 5s. respectively. With instant start gear (220/250 V) these fittings cost £6. 19s. 4d. and £6. 5s. 8d. respectively.

The former new prices apply also to the "Monolux" and "Monolux Junior" fittings by BRITISH THOMSON-HOUSTON CO. LTD., Crown Hse, Aldwych, W.C.2, and to the L.S.1874 and L.S.4007 fittings respectively by THE EDISON SWAN ELECTRIC CO. LTD., 155 Charing Cross Rd, London, W.C.2.

## TRADE PUBLICATIONS

PLASTICS.—"Hellathene" cold water piping is described in a leaflet issued by Hellerman Ltd., Tinsley Lane, Crawley, Sussex.

COMPONENTS.—"Leocasting," a comprehensive service of resin moulding, is surveyed in a leaflet issued by Lion Switchgear Ltd., Twickenham Road, Hanworth, Middx., whose Electronics Division Special Products Department undertakes this work.

RELAYS ETC.—New literature issued by Londex Ltd., Anerley works, 207 Anerley Rd, S.E.20, includes list 164 Synchronous Process Tuner DST. List 65 Delay relay LF/TI, Co-axial relays SCX and GCX (167), list No. 168, Automatic earth leakage equipment E.L.U. and list No. 169, measuring relay type HS/C.

ALUMINIUM.—The Centenary of the founding of the British Aluminium Co. Ltd., occurred last Saturday, 7 May, and to mark the occasion there is available from the company's offices in Norfolk Hse, St. James Sq, S.W.1, a well produced and illustrated History of the Company.

CABLES.—New list from the Saxonia Electrical Wire Co. Ltd., Roan Works, Greenwich, S.E.10, lists heat-resisting asbestos flexibles and cables.

METERING.—The Commander KV flow meter is described in publication ref. 361, just released by George Kent Ltd., Luton, Beds.

INDUCTION HEATING.—Radio Heaters Ltd., Eastheath Ave, Wokingham, Berkshire, have published a book on radio frequency induction heating which illustrates the many successful applications of radio heating.

BELLS ETC.—Commemorating 100 years of progress Julius Sax and Co. Ltd., Commerce Rd, Brentford, have issued an attractive loose leaf booklet of photographs illustrating some of their products.

RESISTANCE MATERIALS.—A leaflet issued by Henry Wiggin and Co. Ltd describes the Bright-ray series of electrical resistance materials and gives brief notes on the type of service for which each grade is intended.

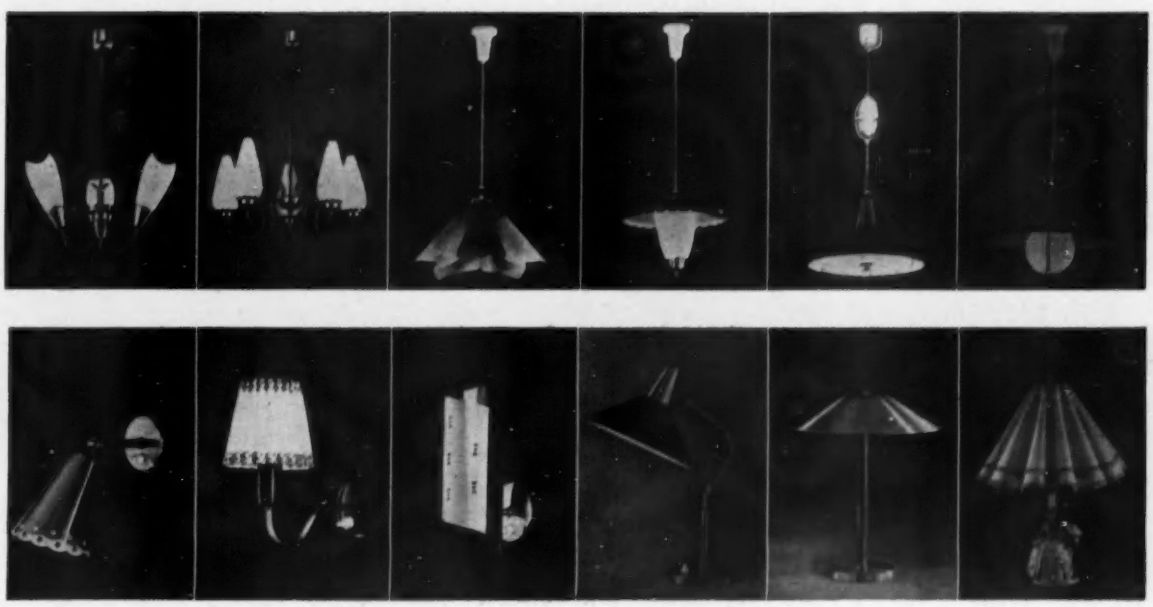
CONTROL GEAR.—New brochure by Allen West and Co. Ltd., Brighton 7, describes the company's range of control gear for water pumping plant.

TOOLS.—Pliers, pincers, nippers, pipe wrenches and spanners available from Wilkinsons Tools Ltd., Kerfoot St, Warrington, Lancs, are listed in leaflet W.152.

ALUMINIUM.—Information Bulletin No. 7 issued by the Aluminium Development Association, 33 Grosvenor St, W.1, gives valuable advice on "Machining Aluminium."

## *New Contemporary lighting from Denmark*

*In contemporary lighting design we can learn much from the Scandinavian countries as is evident from the range of fittings manufactured by an old-established firm in Copenhagen, H. A. Gruberts Sonner. The fittings illustrated are available with others in polished and satin brass and employ glass and plastic shades in red, yellow, white, blue and black. The company is represented in the U.K. by W. W. Trading Co. Ltd., 156, Camden High Street, N.W.1, who co-operated with the Danish company in arranging a small private exhibition in London last week. It is hoped to arrange a further exhibition in June this year when in addition examples of the traditional Danish designs will be displayed*



# NEWS OF THE WEEK

## Atom Exhibitions in Geneva

*British Displays may be Largest in Three Shows*

THREE exhibitions featuring Nuclear Power plant are to be held in Geneva next August during the Conference on the Peaceful Uses of Nuclear Energy. The conference, announced and reported in these columns at the beginning of this year, will take place between 8 and 20 Aug., and the exhibitions will run coincidentally in the Palais Exposition. Two of the exhibitions will comprise exhibits of the Governments of participating countries, over 40 will be represented, and/or their respective Nuclear Energy Departments. One will be of an advanced scientific nature, and the second of a more general character. The third exhibition will be devoted to industrial displays. We understand that the U.K.'s Atomic Energy Dept. will be occupying about 5,000 sq ft of stand space, and that between 10,000 and 12,000 sq ft has been allocated to manufacturers. This country will be taking more space than most, we are informed.

At the time of writing it is not known exactly who or how many of our manufacturers will be exhibiting at Geneva. It is known, however, that over 40 firms concerned with the manufacture of scientific instruments will be participating and at least 20 engaged in reactor development, giving a by no means inconsiderable minimum of 60. As for the Atomic Energy Dept.'s exhibit, this will include models of power stations being built and planned, atomic piles or reactors being built or investigated at Harwell, and a section devoted to isotopes.

British manufacturers will undoubtedly be on the look-out for important European contracts. Readers will recall the remarks made by Dr G. Randers, Norwegian nuclear scientist, in London, just before Easter. He said every small country on the continent would need nuclear energy for industrial uses in the next 20 years, and the U.K. could go into Europe and secure orders for as much as she wanted. The opportunity has been provided. Dr Randers is director of the General Establishment for Nuclear Energy Research at Kjeller.

### Writ issued against Sir Charles Colston

A HIGH COURT writ has been issued on behalf of Hoover Ltd. against their former chairman, Sir Charles Colston, who announced in March that he proposed to establish his own company for the manufacture of domestic appliances. No other details of the writ, which is seeking an injunction against Sir Charles, were given, nor is it known when the case will be heard. Sir Charles joined the newly formed Hoover company in 1919 and resigned last year. According to the annual report and accounts he was paid a sum of £83,575 as compensation for termination of service agreement. When the new company was formed it was stated that their products would not compete in any way with those of Hoover and no official indication was given as to the items to be produced.

### *Oil Burner Agreement*

IT has been announced by Bennis Combustion Ltd., that, following an agreement with Todd Oil Burners Ltd., they are now able to execute complete oil burning installations for shell type and water-tube boilers. Todd Oil Burners Ltd., are an associate company of the Todd Shipyard Corp. of New York and have produced in this country a full range of oil burners for all applications. In consequence of the close co-operation between themselves and the Combustion Equipment Division of their parent company, the British manufactured burners incorporate all the latest American developments in fuel oil burning technique.

### Cable Contract for Henley's

A CONTRACT for the supply and laying of 16,800 yd 0·2 sq in. 132 kV 3-core oil-filled cable has been awarded to W. T. Henley's Telegraph Works Co., Ltd., by the C.E.A. for the N.W. Mersevside and N. Wales Div. The cable will form three feeders each 5,600 yd long, between Agecroft switching station and Bloom St sub-station, Manchester. This link will be by 1¼ miles of 132 kV double-current steel power line awarded to the same company under a previous contract.

### HOPE OF BETTER TRADING RELATIONS WITH U.S.

PROSPECTS of better trade conditions between this country and the U.S. were forecast by the American Secretary of Commerce, Mr Sinclair Weeks, in Birmingham last week. He said it was likely that the U.S. Congress would approve a programme to stimulate two-way trade which would give British industry better selling prospects in the States. Mr Weeks described the American market as one of the easiest to enter.

He said he had found keen interest in Europe in the Buy American Act, and some misconceptions. He explained that regulations were based on a law requiring Government purchases to show preference to American suppliers, and until recently an American bidder might be awarded a contract even if his price was 25% greater. That percentage had now been reduced to between six and ten. The outlook for British exports to the U.S. was good, continued Mr Weeks, because the Eisenhower administration was committed to promoting two-way trade.

### Three Bases devised to pass on Copper Price Benefits

A PROVISIONAL method of passing on the lower copper price provided by the Rhodesian Selection Trust is understood to have been devised by U.K. purchasers. Copper products are to be priced on three distinct bases. A proportion of some products will be based on the R.S.T. price of £280 per ton, other goods on a price of £286, and the remainder of the London Metal Exchange price. The only products to be based on the R.S.T. price will be rolled copper rods, and of these, customers of the refiners and fabricators concerned will receive a proportion at that price and a proportion on the Metal Exchange price. On the other hand all rolled copper sheet will be based on the £286 per ton because it includes some R.S.T. copper and some bought on the Metal Exchange.

### Tariff Protection for S. African Industry

THE S. African Government is planning to impose a special duty on goods imported into the country at below a "reasonable price." Finance Minister, Mr E. Louw, stated in Capetown last week. The duty will be imposed if, after a report by the Board of Trade and Industries, who are recommending the action, the price is adjudged to be below a reasonable level and that importation was likely to be detrimental to industries in the Union producing similar goods.

### Rise for Scottish Electricians

JOURNEYMEN electricians in the contracting industry in Scotland are to receive a further increase of ½d. per hour, with effect from 11 Sept. next, it is now revealed. This is in adition to the 3½d. an hour granted from 13 Mar. last.

# Vast Market for Power Plant in Venezuela

A GREAT deal has been said in the past 12 months about the opportunities which exist in S. America for the development of our export trade. One of the countries offering the best prospects for U.K. exporters is Venezuela, and if any confirmation that a good market exists there is needed, it can be found in the Board of Trade's Overseas Economic Survey for that country just published (H.M.S.O. 3s. 6d.). This survey is of particular interest to the electrical industry.

Oil is the basis of Venezuelan prosperity and, forming 95% of her export trade, is the important factor on which her imports depend. Any recession in the petroleum market would be most serious, and consequently efforts are being made to diversify the economy and open up new industries. Such a policy is, of course, dependent on electric power. Production of electricity has increased greatly but there remains a vast field for expansion. During 1953–54 the Development Corporation invested about Bs. 36m on increasing generating capacity from which over 50 towns benefited, but this was only part of a capital expenditure of between Bs. 200m and Bs. 300m envisaged in the next few years. The plan divides the country into three sections. Major power stations are scheduled for San Lorenzo and Lobaterra in the west and for Puerto La Cruz in the east, an even larger plant is planned at Puerto Cabello for the Central States with expansion at Maracay and Caranero.

Another development programme is being carried out by the Caracas companies, including six more turbines at Tacao. It was recently decided too, to go ahead with a hydro-electric station on the River Caroni. The latter is under the Ministry of Development.

Demand for capital equipment, and for electrical plant especially, is consequently enormous, and is likely to last for many years to come. To date the majority of large contracts for the installation of generating plant have gone to the U.S., but there is now much greater interest in European equipment, in fact, two recent contracts were awarded to French and German firms. There would appear to be no reason why the U.K. should not have as great, if not greater, share in the market. It is worth remembering that last year Venezuela bought more U.K. goods than any other Latin-American country. The survey points out, however, that one cannot trade with Venezuela by post, and strongly recommends visits by U.K. executives, and personal contact.

Venezuela is rich; she knows what she wants; and she is very much a buyers' market. The survey emphasises quick and reliable deliveries, quality and price, generosity of payment terms, attention to import and packing and import regulations, all of the utmost importance.

*Sir Leonard Lord, chairman of British Motor Corpn., Ltd., receiving honorary associateship at Birmingham College of Technology's Diamond Jubilee presentations, from Mr J. J. Gracie, of the G.E.C.'s Witton works and chairman of Governing Body*

## Supply Industry's First Course on Cathodic Protection

FIRST course dealing with the cathodic protection of buried cables to be organised by the electricity supply industry was held at Stowmarket last week under the auspices of the Eastern Board. A comprehensive programme included various fundamental principles, methods of testing, maps and records. Practical demonstrations of methods of testing were given on a model system, and general policy procedure was outlined. Papers and demonstrations were given by Messrs J. H. Gosden, R. A. W. Connor, F. la T. Budgett and L. Whiteley.

The course was organised primarily for Suffolk sub-area and district engineers, but representatives of other sub-areas, as well as representatives from the C.E.A. and four other Boards were also present. They were told that to establish some co-ordination between the various undertakings concerned, a joint committee had been formed. In addition, the Conference of the C.E.A. with Board chief engineers, had established a special panel of its cables committee to deal with cable corrosion and cathodic protection.

*At the Cathodic Protection conference, left to right, Messrs J. H. Gosden and A. T. J. Atkins of the C.E.A., Messrs R. A. W. Connor, G. N. Green, and F. la T. Budgett of the Eastern Board, and Messrs G. Ezard, P. Sydney and L. Whiteley of the Board's Suffolk sub-area*

## *A.P.L.E. Conference at Folkestone opens on 13 Sept.*

ANNUAL conference of the Association of Public Lighting Engineers will take place at Folkestone between 13 and 16 Sept. There will be the usual conference sessions, social functions and exhibition of street lighting apparatus and equipment, with an outdoor display of columns and tower wagons. Conference sessions will be at Leas Cliff Hotel and the exhibition opposite in Langhorne Gardens.

Apart from the Presidential Address by Mr J. M. Waldram, there are to be four papers. The first, on the opening afternoon, will be on "Local Authorities and Public Lighting," by Mr W. H. Shaw. Thursday's two papers will be on "Code of Practice for Lighting of Roads other than Traffic Routes," by Mr J. W. T. Walshe, and "Lighting of Tree-lined Roads" by Messrs H. M. Ferguson and W. R. Stevens. The final paper by Mr J. F. McKenzie on the Friday will be on "Centralised Control of Street Lighting." Social events include a reception by the Mayor and Mayoress of Folkestone on Tuesday, annual luncheon on Wednesday, and the President's reception on Thursday, as well as arrangements for the entertainment of the ladies.

## 1956 Production Census

THE Census of Production for 1956, to be taken during 1957, will be a simplified census taken on a sample basis and similar to that for 1955. Firms with fewer than 11 employees will have to state only their business and number of persons employed. Trades covered will be the same as those included in the 1955 census, namely, mining and quarrying, manufacturing concerns, building and contracting gas, electricity and water.

## OFFICIAL PUBLICATIONS

BRITISH STANDARDS

B.S.2606, 1955: X-Ray Protective Gloves for Medical Diagnostic Purposes up to 100 kV Peak; B.S. 2612, 1955: Electrically-heated Blankets; B.S.2597, 1955: Glossary of Terms used in Radiology.

RAD'O RESEARCH, Annual report of Board for 1954, published for D.S.I.R. by H.M.S.O. (see page 832) 2s. 6d.

N.P.L. NOTES ON APPLIED SCIENCE, No. 10: Noise Measurement Technique; and No. 12: Calibration of Temperature Measuring Instruments.

## *British Cable Factory opened in South Africa*

GROWING demand in South Africa for special types of electric cables for use by the mines, Post Office, railways, municipalities and other industries, and preference for home manufactured goods has led The Telegraph Construction and Maintenance Co., Ltd., through their subsidiary, Telcon Africa (Pty) Ltd., to erect a factory at Wadeville, Germiston, in the Transvaal. The factory was opened by Mr J. N. Dean, chairman of Telcon, who flew out for the ceremony with Mr B. H. Musgrave, director, and Mr C. L. G. Fairfield, general sales manager.

The site covers about six acres and existing buildings have been modified and new ones built with space to spare for future development. Particular attention has been paid to testing and research facilities. Included in the building scheme therefore is a Research Laboratory and Test Dept. equipped with the most modern apparatus. Initially, production will be mainly concerned with thermoplastic insulated cable. A new industry is being established in the Union for the manufacture of certain thermoplastic raw materials, and another of the chief materials required, high purity copper wire, can be obtained locally. In addition modern tin-coating plant is being installed for the provision of tinned copper wire. The sales organisation at Wadeville will also handle the distribution of Telcon's other products.

## An Appreciation of Sir Charles Parsons

PRODUCED primarily as part of the celebrations of the centenary of Sir Charles is a most excellent film dealing with the technical work and discoveries of that great engineer. The film begins by showing both by models and contemporary photographs, as well as by demonstrations of original equipment, the versatility of the work he undertook, concentrating naturally on the development of the steam turbine. In the second part of the film is shown the growth of Heaton Works and the consolidation of the position of the steam turbine as the most important unit producer of power in quantity. The film is not directed at a specialist audience although, to judge from the applause at its showing to a select audience of senior C.F.B. members, consultants and engineers last week, there is much in it of interest even to those well-advanced technically. The main audience for which it has been produced is technical schools, universities and learned societies. Applications from bona fide enquirers for copies on loan should be made to C. A. Parsons and Co., Ltd., Heaton Works, Newcastle-upon-Tyne.

## *Silicones for Industry*

HISTORY, production and application of silicones will be depicted in an exhibition under the above title at the Midland Hotel in Manchester between 13 and 18 June. It is being staged by Midland Silicones Ltd., and invitations can be obtained on request from that company at 19 Upper Brook St, London, W.1. There will be numerous working exhibits on view and films will be shown at regular intervals each day.

## Whitworth Scholarships changed to meet New Needs

CHANGES have been announced in the Whitworth Foundation Awards by the Minister of Education, who is trustee of the Sir Joseph Whitworth Foundation. For some years now, the awards have comprised Senior Scholarships for holders of degrees or H.N.Cs. or Diplomas in Engineering; Scholarships open to engineering apprentices of at least two years' standing; and prizes for unsuccessful candidates for scholarships whose work nevertheless deserved recognition. There has, however, been an increase in the number of maintenance allowances and scholarships from public funds, and those who previously would qualify for a Whitworth Scholarship now qualify for Technical State Scholarships, or remain at school until 18 and then go to a university. At the same time the need for post-graduate awards is growing.

Consequently the maximum number of Senior Scholarships is to be increased from two to three and their value from £325 to £500 p.a. They will be available for post-graduate work and known as Whitworth Fellowships. Award of ordinary Whitworth Scholarships will be discontinued. A number of prizes of greater value will be awarded to unsuccessful but meritorious candidates.

## The First Half-Century

Last Friday evening's discourse at the Royal Institution was given by Professor Ernest Fox Nichols, of New York, on the subject of the pressure due to radiation—that is, the force with which light shoves back anything on which it falls. That there really is such a force was demonstrated experimentally by Professor Nichols at Hanover, in New Hampshire, and by Professor Lebediev in Russia, almost simultaneously. In the library, after the discourse, there was a very fine high frequency apparatus sent by Mr H. W. Cox, wherewith all and sundry could do what a few years ago would have been thought the most impossible of things. —*From our issue of* 18 *May*, 1905.

## £150 Industrial Art Bursaries offered Again

DETAILS of this year's Industrial Art Bursaries Competition, offered by the Royal Society of Arts, were issued last week in a pamphlet, which also gave full information on the results of the 1954 contest. As last year, there are two sections of particular interest to our industry. Travelling bursaries of £150 in value are being offered for the design of domestic electrical appliances and of electric light fittings—both prizes being subscribed by the E.D.A. Conditions of entry will follow similar lines to previous years. Three designs showing perspective and typical working details will be sought in both sections, although as regards lighting fittings, they should utilise tungsten lamps for the home and fluorescent lamps for offices, shops or showrooms. Closing date for entries is 10 Oct.

Notable factor in the results of the 1954 competition was the decrease in the number of candidates. Only six, compared with eight in 1953, competed in the appliance section. The number of competitors in the lighting section, six, was the same. The juries in both cases commented on the small number of entries as well as on a fall in the standard of work submitted. The number of entries in the domestic gas appliances section and the domestic solid fuel appliances section also fell, from eight to five, and from seven to a mere three, respectively.

An exhibition of winning and commended designs in the 1954 competition is now being held at the Royal Society's House in John Adam St, W.C.2. It will close on 28 May.

*Particular interest was shown by the public in the automatic cooker at the S. of Scotland Electricity Board's stand at Edinburgh's Ideal Home Exhibition. The exhibition was opened by Lady Barnett, of TV fame, on 27 Apr, and closed last Saturday*

*Winners of the E.D.A. public speaking competition showing (left to right) Misses N. M. Thornthwaite, A. R. Brown and A. W. Milan, placed first, third and second respectively in the women's section; and Messrs J. A. Brydon Maben, K. A. Anders and C. J. White, who were first, third and second in the men's section*

## *N. Western Board's Hat-trick in E.D.A. Public Speaking Competition*

WITHIN six weeks of their inauguration the S. of Scotland Electricity Board have had their name added to those already inscribed on one of the Faraday Silver Challenge Shields in the E.D.A.'s annual Public Speaking Competition. This year's finals took place at the Connaught Rooms, London, on Wednesday last week. The S. of Scotland Board's success was gained by Mr J. A. Brydon Maben who spoke on "Lighting and Living." The N. Eastern Board may claim some glory from the fact that Mr Maben took up an appointment at Ripon a few days earlier. Mr Maben also competed in the finals last year when he was placed third. Runner-up in the men's section was Mr C. J. White, asst. secretary to the S.E. Electricity Consultative Council, who spoke on "Advertising." Mr H. A. Anders, of the N. Western Board's Clitheroe district, took third place, also choosing "Advertising" as his subject.

The result of the women's section was also remarkable this year. Miss Norma Thornthwaite, service centre assistant at Carlisle, won the Faraday Shield for the N. Western Board. This was the second year running that a finalist from that Board had gained first place. She chose "The Social Influence of Electricity" to speak on. The same subject was the choice of the runner-up, Miss Audrey Milan, a service centre assistant in the Yorkshire Board's Doncaster district. Third place went to Miss Andrena Brown, a demonstrator in the Dunbarton district of the S. of Scotland Board. She spoke on "Lighting and Living." There were eight contestants in each of the men's and women's sections.

In the seven years that the competition has been run, the N. Western Board have gained the women's shield three times. The other year being 1952. The Yorkshire Board have won it twice.

## *Diesel Electric Locos. for Steel Works*

FIRST five of an order for seven 300 h.p. diesel electric locomotives have been delivered to the Steel Co. of Wales. They were designed and made by Brush Bagnall Traction Ltd., and the electrical transmission and controls by Brush Electrical Engineering. The locos have been designed especially to suit the requirements of the Steel Co. The power unit consists of a National six-cylinder pressure charged engine type M4AAU6 developing 300 h.p. at 120 r.p.m. coupled to a Brush self-ventilated compound wound main generator.

## 500,000 TV Sets made by Ferguson at Enfield

A TARGET was realised last week when Ferguson's production of TV receivers at their Enfield factory topped the half million mark. To commemorate the occasion Mr Wilfred Pickles was presented with this 500,000th set, which he handed over to a Mrs Tricker of Colchester. The ceremony was followed by a conducted tour of the works which provided an opportunity to study at first hand the production methods employed. Ferguson's claim is that one set every 29 seconds leaves the line; this being due to the flow production systems used.

## Brazilian Telecommunications Contract placed in Britain

SUBSTANTIAL contracts have been placed by the Companhia Telephonica Brasileira with Standard Telephones and Cables Ltd., through the latter's associated company, Electrica S.A. of Brazil. They include equipment for a complete multi-channel coaxial cable route and a super-high frequency radio network, also for multi-channel telephony and similar to that installed by the British firm in 1952 between Manchester and Kirk o'Shotts television station. The C.T.B. has an ambitious programme for extending telecommunications networks in Brazil and aims to provide extensive additions to existing installations by next year.

## Standards Engineers meet in London

OVER 100 engineers concerned with the application of standards in industrial organisations conferred at British Standards House recently. The conference was arranged jointly by the B.S.I. and Institution of Production Engineers. Similar meetings held in the U.S. have proved most successful in providing the opportunity to exchange ideas on applying standards for the increase of production and the securing of economic benefits. It was decided to hold regular conferences, and the next is envisaged in about six months' time.

General problems were discussed, and among points raised were the method of presentation of standards and the provision of data sheets, which, it was stated, would greatly facilitate the dissemination of information on standards. A committee of standards engineers is to be appointed to discuss matters of general policy on the application of standards in industry.

## M.E.B. INDUSTRIAL DISPLAY

INDUCTION Melting Furnaces are the subject of the next exhibition to be held at the Midlands Electricity Board's industrial showrooms at Chester St., Aston. It will be held between 6 and 18 June, and is being organised jointly by the Board and Birlec Ltd.

## Foreign Money left after Holidays wanted by E.I.B.A.

A NEW way of increasing the Association's funds has been discovered by E.I.B.A. They maintain that every year people return from continental holidays and put the odd foreign currency left over in the back of a drawer and forget about it. Now, by special arrangement, all that currency given to the Association, other than copper coins, can be changed into sterling; and they say, even copper has a melting value.

## WOMAN ELECTROCUTED BY AMATEUR ELECTRIC FENCE

AN electric fence installed by a Bridgnorth (Salop) electrical engineer to keep a herd of goats under control caused the death of his wife. At the inquest, the jury absolved the engineer of all blame and returned a verdict of death by misadventure. The engineer told the court how he took and modernised a derelict cottage, wiring it for light and power. The installation was approved by the Electricity Board. To prevent his goats wandering he decided to erect an electric fence. He said he knew that stock-proof electric fencing in common use was battery energised, but having the mains supply, decided to make use of it. Midlands Board officials, giving evidence, condemned the system.

## NEWS IN BRIEF

Current advertising of the S.E. Electricity Board advises consultation with the Board about wiring. Next month's advertisements will stress electric cooking.

Technical Designs Ltd., industrial advertising specialists, are adding an electronics department to the technical publicity services.

At Bradford City Court a local trader was fined £5 with £2. 2s. costs for trying to sell an electric fire which was not fitted with the required guard.

Thirty-second general meeting and dinner of the British Wireless Dinner Club took place at the United Services. Club. It was attended by 126 of the total membership of 468.

Local labour shortage at Luton has led the Eastern Electricity Board to employ women meter readers, we hear.

Southern Centre of the I.E.E.'s Summer Meeting will be held at Hampton Court on 17 June. The same centre's golf competition will take place at Stoneham Golf Club on the following Tuesday.

Half-yearly Court of Governors of the Commercial Travellers' Benevolent Institution will take place at the Berners Hotel, Berners St, London, W.1, at 12 noon on 18 June.

"Making a Move" is the title of a brochure produced by the L.C.C. to interest owners and managers in the opportunities open to them in country towns which are expanding or considering schemes for expansion.

Pye Ltd., have conducted a sales drive of industrial and underwater television in Zurich occupying three days last week. Main purpose of the exhibition and demonstrations was to show how the technique of television could be applied to production in modern industry.

Selected examples of Italian industrial design will be displayed at an exhibition at 39 Belgrave Sq, London, S.W.1, between 30 June and 30 July. About 30 items will be on view including electric motors and lighting fittings.

# ELECTRIC SUPPLY NEWS

### Barry

The decision of the National Coal Board to supply imported coal to meet a large proportion of the fuel requirements of power stations on the Thames, has seriously affected trade at Barry Docks, it is reported. For many years this coal traffic has been one of the main trades out of the docks, averaging about 20,000 tons weekly. Just recently it has been reduced to about 8,500 tons a week because Continental and American coal is being shipped up the Thames via Rotterdam and Antwerp.

### Chadderton

An application by the C.E.A. to Chadderton Finance Committee for planning permission to erect an overhead power line through part of the district from the Slacks Valley power station, has been deferred until after the next Council meeting. At a recent meeting of the committee the clerk, Mr L. Stott, said there was already a line of pylons along the Middleton boundary to Castleton. Now it was proposed to run another line, through the sewage works to Nordens St, through Chadderton Hall grounds and over the hill to Rochdale. He thought it was likely to spoil the district, and had been told that the Authority could not run the new line parallel with the present lines.

### Douglas (I.o.M.)

Rather than run the risk of it being altered, Douglas Corporation have withdrawn from the Legislature the Bill by which they sought power to make an all-in rate for electricity compulsory on domestic consumers. When the Bill came before the Legislative Council recently standing orders were suspended so that it could be considered, but counsel for the Corporation, Mr E. W. Fargher, announced that if it was amended so that it became a disadvantage to the Corporation they wished to reserve the right to withdraw it. Mr Fargher said the Corporation must, if possible, be given a free hand to work out its own salvation in relation to its electricity undertaking. Sinking funds on the undertaking which were suspended to date amounted to £129,000, he explained, and loan charges next year would total £119,500. In the Bill the fixed charge (10d. in the £ p.q. on rateable value) would be a constant figure which would have borne the cost of interest and sinking fund and wages, and the figure for the unit charge would have borne the cost of coal. Financing the next two years would offer many difficulties for the Corporation, but even after that they would still face a very serious position, because the Electricity Department could not become a charge on the rates. If money were borrowed from the rates one year it had to be paid back the next. Notwithstanding all these difficulties he had been instructed to withdraw the Bill, and this was agreed.

### Largs

A second stage of a scheme for the reinforcement of supply at Largs, and the changeover of the network from 3·3 kV to 11 kV operation, has been approved by the South of Scotland Electricity Board. The scheme, to cost nearly £13,000, involves the replacement of three existing substations by a new 500 kVA substation at Lade St. The substation at Barrfields Pavilion will be re-sited and re-equipped.

### South of Scotland

A scheme for the reinforcement of supply to Kilmarnock has been approved by the South of Scotland Electricity Board. A new 33/11 kV substation will be erected at Langlands St and two 33 kV cables, approximately 1¼ miles in length, will be laid between Langlands St and the Kilmarnock switchhouse at Greenholm St. Estimated cost of the work is £101,700.

### Stockport

Good progress has been made during the past year with electrification of premises in rural districts, it was reported at a recent meeting of the Stockport District Committee of the North Western Electricity Consultative Council. In the period 204 farms had been connected, compared with 136 in the previous year. During February and March, 13 rural development schemes were completed, including 49 farms, and farm work has been started on six new schemes. Negotiations have also been opened regarding two other schemes.

### Ulster

Preliminary exploratory talks have taken place in Londonderry between members and officials of the Corporation and Commodore C. A. R. Shillington, chairman, and officials of the Northern Ireland Joint Electricity Committee, in connection with the proposed new power station in the Province. Londonderry is being considered as a site for the station in view of the fact that within the next few years the Corporation's station will reach its maximum running capacity and the plant will have to be enlarged, we understand.

## LIGHTING SCHEMES

**Enfield.** The Council is seeking M.O.T. approval to a £20,000 scheme for improving street lighting on nine roads.

**Sunderland.** T.C. is seeking loan sanction for £14,858 for street lighting equipment at Grindon Village and the second phase of Farringdon.

**Wandsworth.** The Borough Council has a £160,461 programme for the installation of sodium lighting along 56 classified roads and 170 roads in the borough.

# COMPANY ACTIVITIES

THE trouble about small entities in the electrical industry is that they may be the first to suffer if competition becomes really severe. Veritys Ltd., of Aston, Birmingham, headed by Mr H. B. T. Wilde, last year showed only a small drop in trading profits despite what the chairman described as "increasing overseas competition, with price as the deciding factor." Profits for 1954 were down by £5,000 to £65,477 but owing to a reduction in taxation the net profit reached a record £26,497. The distribution was maintained at 12½% covered nearly twice over.

Orders on hand will keep the works employed for several months ahead but Mr Wilde is afraid the margin of profit will tend to decrease in the face of prices quoted by Continental manufacturers for marine electrical equipment. In the Fan department, Indian and Japanese manufacturers have cut into the Far East market with extremely low prices. Mr Wilde's answer is increased and cheaper production.

It is nice to see a good recovery by Control Systems from the 1953 setback. Group trading profits of the group, which includes the Bell Punch Co. and Sumlock, expanded by about 35% and the dividend has been raised from 13½% to 16%. The recovery is due to expansion in the home trade and cessation of overseas losses. There has been a reorganisation of the overseas arrangements, which can now be regarded as an integral part of the organisation.

Whereas in 1953 the parent company had to provide £37,215 for losses of overseas subsidiaries, Mr Michael Moore, the chairman, said that only the New Zealand interests were still losing money, with the situation now virtually under control.

The hard struggle in the U.S. market still goes on but Australian distributors have more than fulfilled expectations apart from the possible effect of the recent Australian import restrictions. Mr Moore also reports that at home last year one significant development was the introduction of electric Sumlock machines. This resulted in a material increase in Control Systems' share of the office machine equipment market. For the current year volume of business continues at a high level with no sign of orders falling off yet. All departments are busy and production on Air Ministry contracts and for the Paris underground system are expected to be greater than last year. It is a little difficult to understand why the 5s. shares (at 12s. 6d.) should be on a 7½% yield basis.—*From our City Correspondent.*

### Atlas Electric and General Trust

Gross investment income for the year ended 31 Mar. last is £849,535 (*£716,391*), and the net revenue, after taxation, etc., is £395,936 (*£339,003*). The dividend is 6½% (7%) on the increased capital.

### Babcock and Wilcox Ltd.

The value of the output last year was a record, and the volume of orders is still satisfactory although an improvement in raw material supplies, together with the higher output from all the works, has resulted in some reduction in the order book, Mr W. Lionel Fraser, the chairman, reports. Funds must be devoted to the provision of new equipment for the manufacture of heavy vessels and intricate components embodied in the very large high pressure and high temperature plants required today, he adds. A further £100,000 is being transferred to special reserve and development reserve, and the contingencies reserve is raised from £1m to £1½m. The trading figures for the Australian subsidiary beat all previous records, the South African company is filling an important role, while the Brazilian firm should be in production before the end of this year and the first section of the Mexico subsidiary should be operating by next Aug.

| Year to 31 Dec. | £ Trading Profit | £ Net Profit* | % on Ord. Earned | % on Ord. Paid | Ord. Price High | Ord. Price Low |
|---|---|---|---|---|---|---|
| 1950 | 5,141,128 | 1,530,343 | 56 | 15 | 67/– | 55/9 |
| 1951 | 6,448,316 | 2,669,487 | 99 | 18 | 83/3 | 66/9 |
| 1952 | 5,884,776 | 1,914,106 | 68 | 18 | 72/6 | 59/3 |
| 1953 | 5,500,625 | 1,517,537 | 49 | 14½† | 50/– | 40/4 |
| 1954 | 5,727,233 | 1,904,228 | 58 | 15 | 76/3 | 47/3 |

*Attributable to parent company.
†Plus 50% capital bonus.

### Bakelite Ltd.

The heavy explosion at the vinyl resin plant at Aycliffe had put the plant completely out of action, Mr H. V. Potter, the chairman, stated at the annual meeting. But it does not affect any other operations at Aycliffe, he stressed.

### Brazilian Traction Light and Power Co.

There is to be no Ordinary dividend this time, the directors have decided in view of the further deterioration in Brazil's exchange position, and the greatly increased cost to the company of dollar exchange.

### Brilliant Signs Ltd.

Net profit for 1954 is £13,896 (*£9,570*), and a final dividend of 12½% makes the total for the year 17½% (*15%*).

### Burco Dean Ltd.

In connection with the merger of Burco Ltd. and W. H. Dean and Son Ltd., to which we have already referred, acceptances have been received in respect of 97% of the Burco Ordinary shares, 97% of the Dean Ordinary, and 99% of the Dean Preference shares. The offer to the shareholders therefore becomes unconditional.

### Calcutta Electric Supply Corpn. Ltd.

For the year ended 31 Dec. last the gross revenue amounts to £5,291,657, compared with £4,996,114 for the previous year. A final dividend of 3% again makes the total distribution 6%.

### Crofts Engineers (Holdings) Ltd.

Details are now announced of the proposed free scrip and rights issues, for which as we noted last week, C.I.C. consent has been obtained. It is proposed to raise the capital to £2½m by the creation of 4 million additional 5s. Ordinary shares; to capitalise £400,000 of reserves in a one-for-two scrip issue and to vary the Ordinary voting rights. A meeting is being held on 7 June to consider the proposals. After the meeting it is intended to offer 1,200,000 new Ordinary shares to existing holders for cash at a price to be determined.

### R. and A. G. Crossland Ltd.

The past year's profit indicates a steady increase in trading. In view of the increased demand for the company's products, the directors have decided to extend the floor space of the Walsall factory, which it is hoped will be put in hand shortly. A considerable amount of heavy plant was acquired last year, and Mr A. G. Crossland, the chairman, considers that it will add to the company's profit earning capacity this year.

| Year to 31 Dec. | £ Trading Profit | £ Net Profit | % on Ord. Earned | % on Ord. Paid | Ord. Price High | Ord. Price Low |
|---|---|---|---|---|---|---|
| 1951 | 91,828 | 27,566 | 52 | 22½ | 2/9r | 2/3 |
| 1952 | 73,461 | 26,003 | 47 | 22½ | 2/9 | 2/1½ |
| 1953 | 77,978 | 29,620 | 54 | 22½ | 2/6 | 2/0 |
| 1954 | 89,964 | 33,244 | 60 | 27½ | 3/6 | 2/2½ |

### Elliott Brothers (London) Ltd.

The question of raising additional share capital, in view of the present programme of expansion and development, is being considered by the board. So far no decisions have been made, Mr R. E. F. de Trafford, the chairman, states, but further information may be given at the annual meeting in June. As far as the current year is concerned, business is good and the state of the order book remains high. The expansion and development plans will make heavy demands upon the company's resources, and time must elapse before rewards are reaped, he warns. The full accounts lists stocks on hand and work in progress at £736,081, compared with £681,588 a year earlier, the increase being largely due to the acquisition of Bristol's Instrument Co., Ltd.

### Enfield Cables Ltd.

Our reference last week to the sum of £100,000 being spent on plant and equipment related to the year 1954, of course, and not as stated.

### Engineering and Lighting Equipment Co. Ltd.

Trading profit for the year to 31 Mar. last is £258,917 (*£221,412*), and after all charges, including taxation, the net profit is £129,917 (*£84,912*). A final dividend of 15%, again makes the total 30%, but on increased capital.

### W. T. Henley's Telegraph Works Co. Ltd.

The difficult trading conditions last year are reflected in the profit figures given in the accompanying table. But the flow of orders which was low at the beginning of the year, improved in the latter part, and this improvement has continued into the current year, it is stated. Stock in trade at the end of December amounted to £5,730,530 compared with £4,466,071 a year earlier.

| Year to 31 Dec. | £ Trading Profit | £ Net Profit | % on Ord. Earned | % on Ord. Paid | Ord. Price High | Ord. Price Low |
|---|---|---|---|---|---|---|
| 1950 | 1,675,393 | 617,446 | 71 | 20 | 25/- | 21/- |
| 1951 | 1,704,401 | 555,443 | 64 | 20 | 27/6 | 19/3 |
| 1952 | 1,392,118 | 396,600 | 15 | 13* | 20/6 | 14/4 |
| 1953 | 1,350,003 | 553,091 | 20 | 10½ | 19/4 | 15/10 |
| 1954 | 1,049,409 | 494,334 | 18 | 12½† | 22/1 | 15/6 |

*Plus 100% capital bonus.
†Including 2% from capital profits.

### Kenwood Manufacturing Co. Ltd.

British Electric Traction Ltd. has acquired 15% of the issued capital of this domestic appliance concern. Another 15% has been acquired by A. Hurst and Co., who have been export managers for the company for the past seven years. A further 15% of the issued capital has been acquired by another financial interest, it is stated.

### Lancashire Dynamo Holdings Ltd.

With a record volume of unexecuted orders upon the books a satisfactory year is reasonably assured, Mr H. W. Bosworth, the chairman, reports. But the main needs of the electrical industry are a period of stability of wages, sustained effort by every worker and as far as possible, freedom from political interference, he adds. Of the firms in the group he reports that early last year the Willesden works of Lancashire Dynamo and Crypto Ltd. suffered from the falling off of business at the end of 1953. But by the middle of the year all the works were fully occupied and working at their maximum capacity. Activities of Foster Transformers Ltd. were on a like scale. Lancashire Dynamo Switchgear Ltd. and Nevelin Electric Ltd. have both needed room to expand, and since the end of the year a modern factory in 28 acres of ground has been obtained to meet their requirements.

| Year to 31 Dec. | £ Trading Profit | £ Net Profit | % on Ord. Earned | % on Ord. Paid | Ord. Price High | Ord. Price Low |
|---|---|---|---|---|---|---|
| 1950 | 492,229 | 176,859 | 56 | 22½ | 99/- | 90/- |
| 1951 | 578,589 | 203,157 | 33 | 12½* | 56/3 | 42/1 |
| 1952 | 599,556 | 200,531 | 31 | 12½ | 44/6 | 37/6 |
| 1953 | 631,301 | 213,641 | 33 | 14 | 47/- | 41/- |
| 1954 | 671,707 | 256,390 | 38 | 15 | 59/9 | 43/- |

*Plus 100% capital bonus.

### Lisbon Electric Tramways Ltd.

For 1954, the profit is £79,190 (*£79,249*), and a final dividend of 4% again makes the total distribution 6½% tax free.

### Parnall (Yate) Ltd.

Production of washing machines by this concern during 1954 was 2½ times the number made in 1953, and its share of the total market was more than doubled in 1954, the Earl of Limerick, chairman, states. The sale or return methods of trading used by the nationalised industries involves manufacturers supplying these industries in greatly increased costs for about one third of every year. These difficulties could be removed if the nationalised industries and other traders were given a purchase tax registration so that they could stock without having paid p.t. on them, he adds. Referring to the jump in the price of copper over the past year, he said they had the galling experience of reducing their own costs of production but having to increase heater prices substantially in order to recoup the increase in the price of copper. Water heaters were now in production, and others in design, where the use of copper has been almost eliminated or so reduced in quantity as to have an insignificant effect on the prices of heaters.

| Year to 31 Dec. | £ Trading Profit | £ Net Profit | % on Ord. Earned | % on Ord. Paid | Ord. Price. High | Ord. Price. Low |
|---|---|---|---|---|---|---|
| 1950 | 107,454 | 46,867 | 12 | 6 | 4/1 | 2/5 |
| 1951 | 140,900 | 41,877 | 11 | 6 | 4/4 | 3/3 |
| 1952 | 55,082 | 1,317 | — | 6 | 4/7 | 2/10 |
| 1953 | 200,927 | 91,230 | 22 | 8 | 4/8 | 2/6 |
| 1954 | 780,003 | 357,049 | 83 | 14 | 11/4 | 4/- |

### Paterson Engineering Co. Ltd.

Group profit for 1954 is £272,597, compared with £152,640 for the previous eight months. The dividend is 25% (*15% equivalent to 22½% p.a.*).

### Power Securities Corpn. Ltd.

After a substantially increased taxation charge, the net profit for 1954 is £270,524 (*£149,670*). The dividend is raised a further 1% to 9%.

## Sayings OF THE WEEK

*"We must electrify our railways; we have the power to do it, and the branch lines closed up and down the country ought to experiment with electric battery shuttle services . . ."* MR THOMAS JOHNSTON, speaking at Kinbuck.

*"It is the duty of those who employ electrical engineers and specialist technicians to see that their remuneration is commensurate with the importance of the work which they perform. . . ."* MR S. H. HARDING, Chairman of the A.S.E.E., at the annual conference.

*"The atom was split here 15 years ago, and we must see that Britain maintains her lead in developing nuclear power for peaceful purposes. . . ."* LORD JOWITT at the E.D.A. Luncheon.

### Relay Exchanges Ltd.

This concern which became a public company two months ago, reports a group net profit of £147,862 for 1954, compared with £27,534 for the previous period. The dividend is 10% (9%).

### River Plate Electricity and Other Securities Corpn.

There is a final dividend of 10% (*8%*) making a total of 15% (*12%*) for the year ended 15 Apr. last. The net profit for the period is £56,257 (*£48,409*).

### Sangamo Weston Ltd.

The increase in turnover last year reflects the considerable improvement in house service meter business during the second half of the year, and an expansion in sales of time switches, Sir Sam H. Brown, the chairman, points out. Sales for the first quarter of the current year are in excess of the corresponding period of 1954 and represent almost the maximum which can be fulfilled by existing productive capacity. The erection of additional engineering and development laboratories at the Enfield factory, at a cost of £25,000, is now virtually complete, and having acquired 9½ acres of land, it is planned to erect additional manufacturing space, to meet the increasing volume of orders. It is anticipated that a substantial part, if not the whole, of the existing cash balance will be needed for this purpose. To reduce the disparity between the issued capital and the value of the assets employed, consent has been received to the issue of 550,000 new Ordinary 10s. shares. The directors anticipate recommending a dividend of not less than 9% on the increased capital.

| Year to 31 Dec. | £ Trading Profit | £ Net Profit | % on Ord. Earned | % on Ord. Paid | Ord. Price High | Ord. Price Low |
|---|---|---|---|---|---|---|
| 1950 | 310,260 | 107,148 | 62 | 12½ | 24/- | 21/- |
| 1951 | 128,057 | 35,659 | 22 | 12½ | 28/3 | 22/3 |
| 1952 | 217,408 | 69,633 | 42 | 12½ | 25/9 | 19/7 |
| 1953 | 253,709 | 105,806 | 58 | 15 | 21/4 | 17/6 |
| 1954 | 307,658 | 118,043 | 43 | 12½* | 19/4 | 12/10 |

*Plus 50% capital bonus.

### Streamline Filters Ltd.

Consolidated net profit for 1954, after all charges, is £110,758 (*£164,900*). A final dividend of 12½% and bonus of 20%, again makes the total 40%. The directors announce that an offer is pending for the purchase of the whole of the share capital at 47s. 6d. per Ordinary share.

### West London and Provincial Electric and General Trust

A final dividend of 10% and bonus 2% raises the total distribution to 16% (*12%*). Investment income for the year to 31 Mar. last is £88,570 (*£71,579*).

### Dividend Declared

*Drayton Regulator and Instrument Co.* Our note on 7 May, regarding the dividend may have been misleading in view of the changed capital position. The final dividend was 20% on capital increased by 200% scrip bonus, making a total of 23½% (equivalent to 11¾%).

# COMMERCIAL INFORMATION

## Contracts Open at Home . . .

*Dates given are the final for receipt of tenders unless otherwise stated.*

**20 May—Carshalton T.C.** 133 lighting columns along main roads.—See 12 May issue.

**20 May—Durham.** Installation in Bowburn school and Durham school clinic.—See 12 May issue.

**20 May—Edinburgh T.C.** Installation at Calderglen nursery school.—See 5 May issue.

**20 May—Middlesbrough T.C.** Lamps and unit dry cells, and concrete street lighting columns, in year from 1 July.—See 12 May issue.

**21 May—Bexley T.C.** Group A and B sodium street lighting units, and tungsten filament units.—See 5 May issue.

**21 May—Ipswich T.C.** Group A sodium lanterns, control gear, etc., group A tungsten lanterns and steel and concrete columns.—See 5 May issue.

**23 May—Goole T.C.** Installation in 33 houses in Western Rd and Charles Drive.—See 12 May issue.

**23 May.—Peterlee.** Supply and erection of 44 15 ft class B fluorescent street lighting units, for Development Corpn. Contract 43A. Chief Engineer, Shotton Hall, Castle Eden, Durham.

**23 May—Stevenage U.D.C.** Concrete columns, lanterns, etc., for group A lighting along about 2,900 yd of London Rd.—See 12 May issue.

**23 May—West Riding.** Rewiring at Thorne grammar school.—Advertised in 12 May issue.

**23 May.—Wigan T. C.** Electrical installation in various housing schemes.—See 12 May issue.

**24 May—East Riding.** Installation in Beverley, Molescroft school and Driffield school for girls.—See 21 Apr. issue.

**25 May—Birmingham T.C.** Street lighting equipment, including cast-iron and steel columns, lanterns, time switches, etc.—See 5 May issue.

**25 May—Dublin.** Installation in visiting hall at Grange-gorman Mental Hospital.—See 12 May issue.

**25 May—Manchester T.C.** Installation at Smedley Rd secondary school, Cheetham.—Advertised in 5 May issue.

**26 May—Belfast T.C.** 11·8 kV and lower voltage transformers for Power Station West.—Advertised in 14 Apr. issue.

**26 May—Belfast T.C.** Extension to ash handling plant of Power Station West.—Advertised in 14 Apr. issue.

**26 May—Leyton T.C.** Applications invited from electrical contractors to be placed on approved list to carry out various works. They should be returned to Borough Engineer and Surveyor, Town Hall, by above date.

**26 May—Liverpool.** Light and power wiring in Maternity annexe at Sefton General Hospital. G. Chaplin, secretary, S. Liverpool Hospital Management Committee.

**27 May—Heckmondwike U.D.C.** Installation in 10 bungalows on Dale Lane estate.—See 28 Apr. issue.

**27 May—Southport T.C.** Lighting and heating installations in 107 houses on Radnor Drive estate. Borough Architect and Town Planning Officer's Dept., 99-105 Lord St. Deposit £1. 1s.

**27 May—Sutherland.** Installation at Ross House Girls' Hostel, Dornoch.—See 12 May issue.

**28 May.—Longbenton U.D.C.** Supply and erection of 30 sodium vapour street lighting units on concrete columns at Benton. A. E. Sweetman, Engineer and Surveyor, Council Offices, Forest Hall, Newcastle. Deposit £2. 2s.

**28 May—Todmorden T.C.** Sodium lighting units along Rochdale Rd, and Bacup Rd, on steel columns, and supply of cable and galvanised steel tubing.—Advertised in 12 May issue.

**30 May—Edinburgh T.C.** Switchboard at Usher Hall; also installation at Towerbank school.—See 12 May issue.

**30 May—Wing (Beds) R.D.C.** Construction of small electrically-driven sewage disposal plant, at Horton, Bucks. Council's Surveyor, Council Offices, Brooklands, Linslade, Leighton Buzzard. Deposit £2. 2s.

**31 May—Bentley-with-Arksey U.D.C.** Lanterns, lamps, control gear, columns, underground cable for lighting Askern Rd Toll Bar.—Advertised in 12 May issue.

**3 June—Belfast T.C.** $CO_2$ fire fighting equipment at South Central substation.—Advertised in 28 Apr. issue.

**3 June—Heston and Isleworth T.C.** Supply and erection of 56 steel columns and 400 W mercury vapour lanterns, lamps and control gear, for group A lighting along Bath Rd, Hounslow. Borough Engineer's Dept., 88 Lampton Rd, Hounslow. Deposit £2. 2s.—Advertised in this issue.

**6 June—Bushey U.D.C.** Concrete columns, brackets, sodium lanterns, lamps, wiring, etc., along Elstree Rd and Aldenham Rd/Hertspring Lane.—Advertised in 12 May issue.

**6 June—Knaresborough U.D.C.** Supply and erection of 26 fluorescent and 21 filament lamps (group B) with columns, brackets and associated gear. Engineer and Surveyor, Knaresbrook Hse. Deposit £2. 2s.

**6 June.—Peterlee.** Electrical installation in 118 and 92 houses in Acre Rigg sites, for Development Corpn. A. V. Williams, general manager, Shotton Hall, Castle Eden, Durham.

**6 June—Southgate B.C.** Street lighting equipment under two contracts.—Advertised in 5 May issue.

**7 June—Irlam U.D.C.** Supply of 144 Group A lighting points including columns, lanterns, sodium lamps, control gear. Council's Engineer and Surveyor, Council Offices. Deposit £2.

**7 June—Manchester T.C.** Installation in dwellings at Brooklands and Peel Hall.—Advertised in 12 May issue.

**7 June—Newmarket U.D.C.** Supply and installation of 19 Group A fluorescent street lighting units on steel columns, and 33 Group B tungsten units on concrete columns. F. B. Waterfall, Engineer and Surveyor, Council Offices, Severals Hse. Deposit £1. 1s.

**8 June—Derby T.C.** Electrical installation in 46 bungalows on Mackworth estate. Borough Architect, The Council Hse, Corporation St. Deposit £2. 2s.

**8 June—Tillicoultry T.C.** Supply, erection, etc., of 23 concrete columns with sodium discharge lamps along A.91, and 15 similar units along A.903. L. J. D. Smith, Burgh Surveyor, Municipal Bldgs.

**9 June—Co. Down.** Electrical installation at Glastry Intermediate school and meals kitchen, Kircubbin. A. W. Gordon Holt, consulting engineer, 74 South Parade, Belfast. Deposit £5. 5s.

**13 June—N. Ireland.** Installation in county intermediate school at Cloundagh, Portadown.—See 5 May issue.

**13 June—West Riding.** Maintenance of refrigerators.—Advertised in 12 May issue.

**16 June—Watford T.C.** Supply and installation of improved lighting in offices at the town hall. F. C. Sage, Borough Engineer and Surveyor, Town Hall. Deposit £5. 5s.—Advertised in this issue.

**23 June—Manchester T.C.** Electrical installation in Home for Aged in Sale Rd. City Architect, P.O. Box 488, Town Hall.—Advertised in this issue.

**28 June—Goole T.C.** Supply of 300 kVA diesel alternator and duplicate busbar switchgear. Thos. Waterfall, Borough Surveyor, Municipal Offices.

## Your Queries Answered

*Readers are invited to make use of our free enquiry department which possesses wide resources including an index of trade information with over 100,000 entries*

***A Selection from the 128 queries answered this week***

**"Sololite" directional bed-light,** makers of? D.E.—Olivex Co., Ltd., 102 Albany St, N.W.1.

**"Lexington" waffle irons,** address for? I.P.—A. G. Field and Co., Ltd., 10 Devonshire Row, E.C.2.

**"Kaloric" convector heater,** makers of? E.H.—M. and J. Lossos and Co., Ltd., 31 Beethoven St, W.10.

**"Nodark" miniature circuit-breakers,** makers-of? R.E.—Power Equipment Co., Ltd., Kingsbury Works, Kingsbury Rd, N.W.9.

**Pictorial Machinery (Engrs.) Ltd.,** address for? S.C.—Lithotex Works, Kelvin Way, Manor Royal, Crawley.

**"Theco" heating irons,** makers of? P.E.—Theco Electrical Appliances Ltd., 33 Theobalds Rd, W.C.1.

**"Gem" vacuum cleaners,** repairs of? W.H.—Vacuum Cleaner Service Co., 233 Cricklewood Broadway, N.W.2.

**"Versalite" travelling lamp,** makers of? E.B.—L. and J. Clarke, 10 Colebrook Rd, Southwick, Sussex.

**7 July—Edinburgh T.C.** Electrical heating and ventilation at Liberton secondary school. Apply by 1 June to Rowand Anderson, Kinninmouth and Paul, 16 Rutland Sq.

**9 July—Co. Louth.** Pumping and water filtration plant in supply system for villages of Louth, Mullacrew and Tallanstown.—See 12 May issue.

**No date stated—Durham.** Installation at Stockton fire station and police houses at Seaham.—See 5 May issue.

**No date stated—Inverness.** Supply of electric lamps to Board of Management of Inverness Hospitals in year from 1 July. E. W. M. Watt, secretary and treasurer, 14 Ardross St.

**No date stated—Sherburn (Dur).** Applications invited for renewal and rewiring of electrical system at St Mary's Church. Details from S. Moody, 16 Grey Ave.

**No date stated—Wakefield T.C.** Supply and erection of 19 25 ft concrete columns with 400 W H.P.M.V. lamps in medium beam angle lanterns and 14 15 ft concrete columns with 100 W tungsten lamps in totally enclosed lanterns. City Engineer, Town Hall.—Advertised in this issue.

## . . . and Overseas

*Details of items marked * may be obtained on application to the Board of Trade, Lacon House, Theobalds Rd, W.C.1, quoting reference.*

**7 June—U.S.A.** Bureau of Reclamation invites tenders (No. DS.4407) for supply of one 115 kV power circuit-breaker for Belden substation. Bureau is at Building 53, Denver Federal Center, Denver 2, Colorado. B.o.T. (Ref.: ESB 9626/55).*

**15 June—S. Rhodesia.** Supply of 6 automatic closing 11,000 V, 3-phase outdoor pole-mounting oil circuit-breaker reclosers for rural schemes. Contract E.64/1955. Electricity Dept., Municipality of Umtali. B.o.T. (Ref.: ESB 10013/55).*

**16 June—Portuguese E. Africa.** Ports, Railways and Transport Dept. at Lourenco Marques invites tenders (98/55) for 38 items of electrical equipment, including cable, carbon brushes, shunt coils, manual starters for electric motors, etc. B.o.T. (Ref.: ESB 9719/55).*

**20 June—Australia.** Contract 427 of Electricity Commission of N.S.W., calls for 91 33 kV outdoor circuit-breakers and current transformers. Commission is at Kelvin Hse, 15 Castlereagh St, Sydney. B.o.T. (Ref.: ESB 9517/55).*

**20 June—Australia.** Following for Wallerawang power station: two indoor type natural circulation water tube boilers; piping installations; and four electrically driven boiler feed pumps. Contract No. 450. Electricity Commission of N.S.W., Box 5257, G.P.O., Sydney. B.o.T. (Ref.: ESB 8849/55).*

**27 June.—Australia.** Supply of four 15 MVA 16 kV outdoor oil-immersed weatherproof transformers, for Electricity Commission of N.S.W., Kelvin Hse, 15 Castlereagh St, Sydney. Contract 380, B.o.T. (Ref.: ESB 9518/55).*

**27 June—Egypt.** Two 5,000 kV turbo-alternator sets, two 600 kV house turbo-alternator sets, and steam generating plant with auxiliaries, switchgear and transformers, for Ministry of Public Works, Mechanical and Electrical Dept. Documents from Commercial Counsellor, 24 South St, London, W.1, at £E.10.

**5 July—Iraq.** Supply, erection at Shamiya power station of complete generating plant of capacity of 250 kW including switchboard, all engine auxiliaries, fuel oil storage tank, travelling crane. Directorate-General of Municipalities, Baghdad. B.o.T. (Ref.: ESB 9485/55).*

## PRICES of cable metals and other materials

*Figures quoted are the official prices ruling on Tuesday, 17 May*

| | £ per ton | Weekly change £ | Price last year £ |
|---|---|---|---|
| COPPER, standard class A (settlement) | 326 | +21 | 242 |
| ,, (3 months) | 307½ | +18½ | 238½ |
| R.S.T. (Rhodesian Selection Trust) group price* | 280 | — | — |
| LEAD, refined pig, min. 99·97% purity (cash) | 103½ | +1 | 94½ |
| ,, (3 months) | 103½ | +½ | 92½ |
| TIN, refined, min. 99·75% purity (settlement) | 713 | +1 | 722½ |
| ,, (3 months) | 714½ | — | 721 |
| ALUMINIUM, ingots 99·99·5% | 163 | — | 156 |
| ZINC, virgin, min. 98% purity (cash) | 89½ | — | 79½ |
| ,, (3 months) | 88½ | — | 79 |
| RUBBER No. 1, RSS. spot (per lb.) | 28⅝d. | +1½d. | 19½d. |
| ,, c.i.f. basis, ports. July (per lb.) | 26½d. | — | 19 1/16d. |
| ARMOURING : | | | |
| Galv. Steel Wire (0·104 in.) | 52½ | — | 52 |
| Mild Steel Tape (0·014 in.) | 41½ | — | 40½ |

(*Fixed price c.i.f., U.K. for 30 days from 9 May to "consumers willing to instil a degree of stability into the resale price".)

**5 July—New Zealand.** Wellington City Corporation's Transport Dept. invites tenders (contract T.5) for 33 trolleybuses of forward-control type, for one-man operation and with full-fronted all metal bodies. B.o.T. (Ref.: ESB 7144/55).*

**7 July—Australia.** One 20 MVA three-phase transformer for E. Perth generating station. Specification No. 15/E.P. State Electricity Commission of Western Australia, 321 Murray St, Perth. Documents at £1. 1s. available from Agent-General at 115 Strand, London, W.C.2.

**11 July—Iraq.** Supply and erection at Zakho of three 75 kW diesel driven alternator sets with switchboard, control panels, small wiring, etc., etc. Tender No. 111. Directorate-General of Municipalities, Baghdad. B.o.T. (Ref.: ESB 8853/55).*

**12 July—Egypt.** Erection at Atf power station, Mahmoudia, of extra 15,000 kW turbo-generator unit, with steam boilers, transformers, electrical apparatus, etc. Documents at £E.10 from Egyptian Embassy, 75 S. Audley St, London, W.1.

**17 July—India.** Tenders (No. PTC 2904/55-56/A) invited by Bombay Electric Supply and Transport Undertaking, for supply of and erection of 22 kV and 6·6 kV switchgear and accessories for main receiving stations at Esplanade and Mahalutim. B.o.T. (Ref.: ESB 9365/55).*

**19 July—Iraq.** Supply and erection of two 250 kW alternator sets with switchgear, atmospheric coolers and overhead crane; supply only of a 250 kW and a 90 kW alternator to replace existing d.c. generators; and supply and erection of 500 kVA transformers at Baqouba. Directorate-General of Municipalities, Baghdad. B.o.T. (Ref.: ESB 9482/55).*

**5 Aug.—India.** Turbo-alternator set of 5,000 kV with accessories; two water tube boilers of 35,000 lb/hr capacity with accessories; 11 kV and low voltage switchgear with cables; for Jaipur steam power station, Rajasthan. Project SE2/2858/Jaipur. Directorate-General of Supplies and Disposals, Shahjahan Rd, New Delhi. B.o.T. (Ref.: ESB 9775/55).*

**9 Aug.—India.** Project SE2/2858-E/Jodhpur calls for two turbo-alternator sets of 3,000 kW capacity with accessories, two water tube boilers of 45,000 lb/hr capacity with accessories; indoor and outdoor switchgear with cables for Jodhpur steam power station, Rajasthan. Directorate-General, Supplies and Disposals, Shahjahan Rd, New Delhi. B.o.T. (Ref.: ESB 9492/55).*

**10 Aug.—India.** Following tenders, all separate, invited: (*a*) two turbo-alternator sets, boilers with auxiliaries and associated switchgear for Bharratpur steam power station; (*b*) same for Bhilwara steam power station, Rajasthan; (*c*) same for Alwar steam power station; and (*d*) same at Kotah station. Project No. SE2/2858/E/Other stations. Directorate-General, Supplies and Deposits, Shahjahan Rd, New Delhi. B.o.T. (Refs.: ESB 9771/55, 9772/55, 9774/55, and 9773/55).*

**15 Sept.—Philippines.** Among requirements wanted for cement plant are insulators for transmission line, cables for same, diesel generators and other electrical apparatus. F. O. A. Procurement Authorisation no. 92-00-70-75-5205. Republic Cements Corpn., Amon Trading Building, Bonifacio Drive, Manila. B.o.T. (Ref.: ESB 9815/55).*

**20 Sept.—India.** Tenders invited for (i) 100,000 kVA a.c. generators with exciters and voltage regulators for Bhakra power plant; and (ii) 125,000 h.p. hydraulic turbines with governors for same. Documents at Rs. 100 in respect of each of (i) and (ii) from Director of Designs, Bhakra Dam Directorate, Kakanager, Cornwallis Rd, New Delhi.

## Contracts Placed

**Basildon (Essex).** Phase two of street lighting on Nevendon industrial area for Development Corpn., Erecon Ltd, £1,470.

**Darlington T.C.** Supply and installation of equipment for stage 2 of sodium street lighting in Coniscliffe Rd, Revo Electric Co., Ltd., £2,658.

**Isle of Ely.** Installation at College of Further Education and Horticultural Inst., Ely Electrical Co., £5,239.

**London.** Renewal and improvement of installation at Balham and Tooting College of Commerce, A. A. Electrical Co., Ltd., £2,672.

**Longbenton U.D.C.** Street lighting equipment at Seaton Burn, Concrete Utilities Ltd.; installation in 30 houses at Forest Hall, J. B. Wilson.

**Longford (Eire).** Installation in hostel at Mullingar Mental Hospital, T. Walley, Dublin, £1,517.

**Newcastle-on-Tyne.** Installation at eye outpatients' dept. at Newcastle General Hospital, Reid Ferens and Co., Ltd., £2,424.

**Rotherham T.C.** Renewal of three miles of trolleybus wire, British Insulated Callender's Cables Ltd., £1,680.

**Woolwich B.C.** Fluorescent fittings for Town Hall and Municipal Offices, British Thomson-Houston Co., Ltd., £1,056.

# BUSINESS PROSPECTS

## Home

**Acton (Middx).** Extensions and new floor at Y.W.C.A. in East Acton Lane. James and Bywaters, 5 Bloomsbury St, W.C.1, are architects.

**Co. Antrim.** Construction of 137 dwellings at Ballyclare for N. Ireland Housing Trust, 12 Hope St, Belfast.

**Aylesbury (Bucks).** Factory proposed by Negretti and Zambra Ltd. is estimated to cost £120,000. Architects are P. H. Clarke and Son, 7 Ely Place, London, W.C.2.

**Ayr.** Approval granted for erection of 304 houses at Beith, Dundonald, Dunlop, Dreghorn, Kilbirnie and Springside.

**Barking T.C.** It is proposed to erect 33 flats at corner of Ripple and Westbury Rds.

**Barnard Castle.** Layout plans prepared by R.D.C. architect, J. Lawton, of 45 Galgate, for erection of 84 houses on Red House estate, Etherley.

**Barnes T.C.** Erection of 16 flats in Mortlake High St. Borough Engineer and Surveyor, Municipal Offices, Sheen Lane, S.W.14.

**Barnsley.** Development scheme for St. Helen Hospital submitted by Sheffield Hospital Board. Cost estimated at £750,000.

**Belvedere (Kent).** New seamen's home to be built for Royal Alfred Merchant Seamen's Soc., 76 Ibex Hse, Minories, E.C.3, at cost of about £150,000. Architects are Collins, Melville, Ward and Partners, 15 Manchester Sq, W.1.

**Bridgnorth T.C.** Construction of 40 houses on The Grove estate. Council's Architects, Bournville Village Trust, Architects' Dept., Estate Office, Bournville, Birmingham.

**Chatham T.C.** Tenders may soon be invited for erection of shops, flats and maisonnettes on Weeds Wood estate.

**Chesterfield R.D.C.** Erection of 26 houses and 4 bungalows at Beighton, 30 houses and 4 bungalows at Eckington, 8 houses at Shirland, 49 at Brimington, and 4 at Walton. Engineer and Surveyor to Council, Rural Council Hse, Saltergate, Chesterfield.

**Chesterfield T.C.** Erection of 66 houses on Pevensey estate. Borough Engineer and Surveyor, Town Hall.

**Crook and Willington U.D.C.** It is proposed to erect 50 houses on Hall Lane estate, 40 at Hunwick, and four shops and flats on Wear Valley estate. Council's architects are Page, Son and Hill, 75 King St, South Shields.

**Dagenham.** Plans in hand for erection of factory in Selinas Lane for A. Gaverin Ltd., Mansion Hse Station Building, Cannon St, E.C.4.

**Dartford.** Quantity surveyors for phase 2 of modernisation of Darenth Pk Hospital are Arthur Boxall and Partners, 7 Queen Anne's Gate, S.W.1.

**Derbyshire.** Expenditure of £500,000 approved for erection of buildings at Eckington comprehensive school, S. Normanton and Pinxton county secondary school, Chesterfield Whittingdon county secondary school, and Tupton Hall grammar school, Clay Cross.

**Durham.** County's £13m scheme providing for five technical colleges, 19 colleges of further education, six recreational centres, and numerous community and youth centres, has been approved. Ultimate cost of technical colleges at Bishop Auckland, Durham, Easington, Hebburn and Stockton, will be £2,621,356.

**Glasgow T.C.** Erection of 30 flats in Wedderlea Drive and 6 each in Cairn St and Closeburn St. Architectural and Planning Dept., 20 Trongate.

**Hailsham (Sus).** Draft bills of quantities submitted for neurosis unit to be built at Hellingly Hospital. Cost estimated at £131,000.

**Harrow.** New church, vicarage and hall at St Andrew's Church, Roxbourne. Architects are C. A. Farey, Son and Adam, 83 Prince Albert Rd, Regent's Pk, N.W.8. Cost estimated at £70,000.

**Holborn.** Central library proposed in Theobalds Rd at cost of about £214,500 (including land).

**Huntingdonshire.** Preliminary plans being considered for new country buildings.

**Longbenton.** Site at Holystone allocated to Gibson Readymixed Concrete Ltd., of Gosforth, for erection of factory.

**Maltby (Yorks) U.D.C.** Plans approved for county fire station in High St.

**Manchester T.C.** Construction of 74 maisonnettes and flats at Wythenshawe, 122 at Middleton, 22 at Collyhurst, and 15 houses at Moston. Director of Housing, Town Hall.

**Mottingham (Kent).** Architects for erection of St Edward's Church are David Nye, Westminster Chambers, 7 Victoria St, S.W.1.

**Newcastle-on-Tyne.** British Railways to carry out improvements to lighting at Central Station.

**Northumberland.** Tenders will probably be invited in autumn for first stage of large development scheme at Prudhoe and Monkton Hospital to be carried out by Newcastle Hospital Board. Same Board also proposed alterations and additions costing £24,000 at Morpeth Cottage Hospital.

**Orkney.** Education Authority has approved various projects, including erection of primary school at Kirkwall (£130,000); school at Harray (£21,000), hostel (£35,000), Kirkwall grammar school and Stronsay Central school (£30,000 each).

**Padiham (Lancs).** About 14½ acres of land to be purchased by Glover and Main Ltd., gas appliance makers, 48 Grosvenor Gardens, London, S.W.1, for erection of new factory. First stage will cost about £500,000.

**Peterborough T.C.** Total of 204 dwellings to be built on Welland Rd estate.

**Sheffield.** Electrical rewiring schemes involving expenditure of over £32,000 are planned by Regional Hospital Board.

**Sheringham (Norf) U.D.C.** Erection of block of 12 flats off Cromer Rd. J. H. Ashton, clerk, U.D.C. Offices.

**Stockton-on-Tees T.C.** Erection of junior and infant school in Redbrook Ave, Roseworth. Borough Architect, 28 The Square.

**Walsall.** Wilmot Breeden Ltd., Western Works, Birmingham, to build new factory in Hatherton Lane, Bloxwich.

**Walton and Weybridge U.D.C.** Erection of 52 houses on Hersham Rd site. Engineer and Surveyor, Council Offices, Walton-on-Thames.

**West Hartlepool T.C.** It is proposed to include £280,000 scheme for construction of transport depot in building plans for next few years.

**West Lothian.** Approval granted for erection of R.C. primary school at Bathgate and extension to Bo'ness Academy. Estimated cost £150,000 and £90,000 resp.

**Worcester T.C.** Construction of 30 houses on Warndon site. City Engineer, 22 Bridge St.

## Overseas

**South Africa.** Southern Automatics (Pty) Ltd., 306 Point Rd, Durban, are interested in representing in Natal as distributors or agents, U.K. manufacturers of electrical and mechanical instruments for industrial purposes. They include pressure indicators and recorders, flow meters and recorders, level meters and recorders, pyrometers, automatic controllers and recorders.

# Gazette Announcements

### COMPANIES ACTS

**Jack Harvey Ltd.** A. W. Hunter of Walter Hse, 418-22 Strand, London, W.C.2, has been appointed liquidator with committee of inspection.

**M. J. Parsons (Bournemouth) Ltd.** Resolution for winding-up passed at meeting on 29 Apr. A. Stanley Orme of Webb Krinks and Thomas, 1-2 Sandringham Mansions, Exeter Rd, Bournemouth, has been appointed liquidator, and creditors are asked to send particulars to him by 31 May.

**Empire Electric Co. (Hounslow) Ltd.** Winding-up order date 9 May. Petition presented on 20 Apr.

**A. C. Cash Ltd.** Resolution for voluntary winding-up passed at meeting on 6 May, when H. A. Marshall, cert. acc., 35 Rodney Rd, Cheltenham, was appointed liquidator.

### BANKRUPTCY ACTS

*Intended Dividends*

**Warwick.** Derek G. H. Hammerton and Arthur J. Cummings trading together as A. C. D. Electric Co., at 28 West St, Warwick. Last day for receiving proofs, 25 May. Trustee is R. K. Clark. Official Receiver, Somerset House, 37 Temple St, Birmingham.

*First Meetings*

**Brighton.** M. O'Rourke, electrical contractor of 52 Woodlea Rd, Worthing. First meeting will take place at Official Receiver's Office, 8 Old Steine, Brighton, tomorrow (20 May) at 11.30 a.m. Public examination at Court House, Church St, Brighton, on 17 June at 10.30 a.m. Date of receiving order, 5 May.

**Wandsworth.** Albert A. Barnes, electrician trading at 61 Oxford Rd, Exeter. First meeting at 58-61 York Terr., Regent's Park, London, N.W.1, on 24 May at 2.15 p.m., and public examination at Court House, Garratt Lane, Wandsworth, S.W.18, on 15 July at 10.30 a.m.

*Release of Trustee*

**Barnstaple.** George R. Roswall, electrician trading at The Corner Hse, St, Giles, Torrington. Trustee was G. W. Sisman, Official Receiver, 12 Pennsylvania Rd, Exeter.

*Dividends*

**Birmingham.** Stanley Sidwell, electrical engineer of 51 Islington Row, Birmingham. First and final dividends of 20s. in £ payable on 24 May at Official Receiver's Office, Somerset Hse, 37 Temple St, Birmingham.

# NEW COMPANIES

*Extracted from the Register issued by Jordan and Sons, Ltd., 116 Chancery Lane, W.C.2.*

**Electro Physical Laboratories (Wender) Ltd.** 96 Belsize Lane, N.W.3. Nom. cap.: £100. Dirs.: E. J. Wender, Agnes B. Wender and J. M. Wender.

**Electro-Plumb Ltd.** Bank St, Chepstow, Mon. Electricity, heating, plumbing and mechanical and general engineers, etc. Nom. cap.: £2,000. Dirs.: P. M. Ingledew, G. R. Newman and J. M. Ingledew.

**J. H. Humphreys and Sons Ltd.** Manufacturers of electro-magnetic chucks and apparatus and equipment, electrical and mechanical engineers, etc. Nom. cap.: £100,000 Dirs.: to be appointed by subs. Subs.: A. Robinson, 2 The Green, Baslow, Bakewell, and A. N. Brown, 31 Aldred Rd, Sheffield, 10.

**L. T. Accumulators Ltd.** 118a Askew Rd, Shepherds Bush, W.12. Battery specialists, etc. Nom. cap.: £1,000. Dirs.: C. Latham and Rosalina C. Latham, W. H. Taylor and Ivy D. Taylor.

**Brinds Investment Co., Ltd.** 14 Green Lane, Thornton Heath, Surrey. Buying and selling new and used motor vehicles, parts, accessories, supplies, radios, cycles, motor cycles, motor boats and all kinds of machinery, rubber goods, electrical goods; to finance the purchase, hire-purchase or sale of any such vehicles or their accessories, etc. Nom. cap.: £1,000. Dirs.: C. F. Rushworth and J. J. Marks.

**Ariel Sound Ltd.** Manufacturers of and dealers in gramophone records, gramophones and sound reproducing machines, electricians, radio and television engineers, etc. Nom. cap.: £100. Dirs.: J. F. K. Nosworthy and Mrs B. J. Nosworthy, 57 Lancaster Mews, W.2.

**Christopher Boyles Ltd.** Manufacturers of and dealers in electrical and mechanical equipment of all kinds, etc. Nom. cap.: £100. Permanent directors: C. Boyles and Mrs. G. Boyles, Milwood, Hill Drive, Hove, 4.

**Bewley and John Ltd.** Foynes, Halfway, Llansamlet, Glam. Civil, constructional, mechanical, electrical and general engineers, etc. Nom. cap.: £10,000. Dirs.: J. C. Bewley and Mrs. C. C. Bewley.

**Proban Ltd.,** Trinity St, Oldbury, Birmingham. To conduct and promote either by financial assistance or otherwise research into methods and processes designed to render materials of any description resistant to heat or temperature or any other particular condition, etc. Nom. cap.: £1,000. Dirs.: not named. Subs.: B. Topley, Compton Hse, Kinver, nr. Stourbridge, and J. G. Evans, Fieldhead, Menston-in-Wharfedale, Yorks.

**K. Dykes Ltd.** Electricians, mechanical engineers and manufacturers, etc. Nom. cap.: £10,000. Dirs.: Not named. Subs.: Evelyne M. Bayne, Newlands, Crowthorne, Berks, and Edith E. H. Goodband, 5 Park Rd, Camberley, Surrey.

**Nonius Ltd.,** 38 Beethoven St, W.10. Agents for engineering, electrical and similar items; engineers, electricians, etc. Nom. cap.: £1,000. Dir.: E. Weiss.

**Charles W. Brumfitt Ltd.,** 37a Emerald St, York. Plumbers and sanitary, hot water, heating, mechanical, electrical, gas and general engineers, etc. Nom. cap.: £5,000. Dir.: C. W. Brumfitt.

**Richard Graydon Ltd.,** 11 Greek St, W.1. Manufacturers, merchants, importers and exporters of and dealers in general merchandise, and in particular electrical and general engineers, etc. Nom. cap.: £100. Dirs.: R. E. Hood and G. E. Owen.

**W. R. Ford and Son Ltd.,** The Works, Mill Rd, Salhouse, Norfolk. Motor, mechanical, electrical, marine, aeronautical, gas and general engineers and contractors, etc. Nom. cap.: £15,000. Dirs.: W. R. Ford and A. R. Ford.

**Jos. Rivlin and Co., Ltd.,** 104 Lumb Lane, Bradford. Electric engineers and general electrical installation contractors, etc. Nom. cap.: £5,000. Dirs.: J. Rivlin and H. Rose.

**Asquith and Co. (Refrigeration) Ltd.,** 61/3 Northolt Rd, Harrow, Middx. Dealers in refrigeration plant, radio and television, etc. Nom. cap.: £5,000. Dirs.: H. C. F. Asquith, Mrs R. L. Asquith, and G. F. Old.

**Arnold (Electrical) Ltd.,** 2/5 Old Bond St, W.1. Manufacturers of and dealers in electrical goods of all kinds, wireless and television sets, etc. Nom. cap.: £2,000. Dir.: A. Hershman.

# TRADE NOTES

**New Telephone No.** The telephone No. of Nagard Ltd., 18 Avenue Road, Belmont, Surrey, has been changed to Vigilant 9161.

**Change of name.** In view of the increased activities in recent years in which Riley Stoker Co., Ltd., have engaged, the name of the company has been changed to Riley (IC) Products Ltd.

**Holidays.** The works of Holophane Ltd., at Elverton St, Westminster, S.W.1, will be closed for the annual holiday from 18 June to 2 July inclusive.

**New Depot.** Johnson & Phillips Ltd., have this week opened a depot at Spital House, Spital Hill, Sheffield 4. Telephone, Sheffield 22893. In charge of the depot is Mr P. C. Dougherty, who was previously at the firm's Ipswich branch.

**Beama Contract Price Adjustment Formulæ.**—*For Electrical Machinery and Equipment.* For purposes of calculating variations in: (*a*) "Rates of Pay"—the rate of pay for adult male labour at 14 May, 1955, shall be deemed to be 162s.;; (*b*) "Cost of Material"—the index figure for materials used in the Electrical Machinery Industry published in the Board of Trade Journal on 14 May, 1955, is 181·7.

*For Turbo-Generating and Allied Plant.* For purposes of calculating variations in: (*a*) "Rates of Pay"—the rate of pay for adult male labour at 14 May, 1955, shall be deemed to be 162s.; (*b*) "Cost of Material"—the index figures published in the Board of Trade Journal on 14 May, 1955, are: Materials used in Mechanical Engineering Industries—163·6, "Blast Furnaces and Iron and Steel Melting and Rolling (40 and 41)"—147·7. The price of brass condenser tubes, ¾ in. o/d 18 s.w.g. published in *The Metal Bulletin* on 13 May, is 4s. 1¼d. per lb.

*For Outstanding Contracts covered by the B.O.T. Intermediate Products Index.* For purposes of calculating variations in (*a*) "Rates of Pay"—the rate of pay for adult male labour at 14 May, 1955, shall be deemed to be 162s.; (*d*) "Cost of Material"—the index figure for Intermediate Products published in the Board of Trade Journal on 14 May, 1955, is 373·1 (provisional).

**Acquisition.** The Strong Fortress arc lamp business has been acquired by S. H. Muffett Ltd., of Tunbridge Wells, from the Strong Electric Corporation (Gt. Britain) Ltd. The former company have manufactured the Strong Fortress arc lamps for a number of years, and will now market them and handle spares.

# TRADE MARKS

*This information is extracted from the Official Journal by permission of the Controller.*

**Igranohm.** 739,409. Class 9. Apparatus and instruments. Igranic Electric Co., Ltd., Elstow Rd, Bedford.

**Costmaster.** 739,772. Class 9. Thermostats. Norman Stone and Co., 160 Earls Court Rd, S.W.5.

**Autostat.** 739,969. Class 9. Thermostatically operated switches. Arcolectric (Switches) Ltd., Central Ave, West Molesey, Surrey.

**Micron.** 740,048. Class 9. Plugs and sockets. Painton and Co., Ltd., Bembridge Drive, Kingsthorpe, Northampton.

**Telecator.** 740,386. Class 9. Level indicators. Hopkinsons Ltd., Britannia Works, Wheathouse Rd, Huddersfield.

**Rem.** 730,692. Class 2. Fires, heating elements and oil panel heaters. Remploy Ltd., 25/28 Buckingham Gate, S.W.1.

**A Voz do Dono** (in design). 739,513. Class 9. Apparatus, instruments, etc. Gramophone Co., Ltd., Blyth Rd, Hayes, Middx.

**MR.** (in design). B722,713. Class 9. Irons, door chimes, bell transformers, etc. B722,715. Class 2. Toasters, space heaters and pokers. B722,714. Class 10. Warming pads. Morphy-Richards Ltd., St. Mary Cray, Kent.

# MEETINGS TO NOTE

**THURSDAY, 19 MAY**

I.E.E. (London). Annual meeting. Followed at 6.30 p.m. by "Human Relations in Industry," Lord Citrine. Savoy Place, W.C.2.

I.E.E. (Irish). Annual meeting at 59 Merrion Sq, Dublin.

Royal Soc. of Arts. "Scientific Research in India." Viscount Waverley. Society is at John Adam St, W.C.2, 5.15 p.m.

**FRIDAY, 20 MAY**

I.E.E. (Western). Summer meeting at Carlyon Bay Hotel, St. Austell, until 23 May.

A.S.E.E. (Watford). "Industrial Psychology." A. Angles. Clarendon Hotel, 3 p.m.

**SATURDAY, 21 MAY**

I.E.E. (London Utilisation). Summer visit to Atomic Energy Research Establishment, Harwell.

**THURSDAY, 26 MAY**

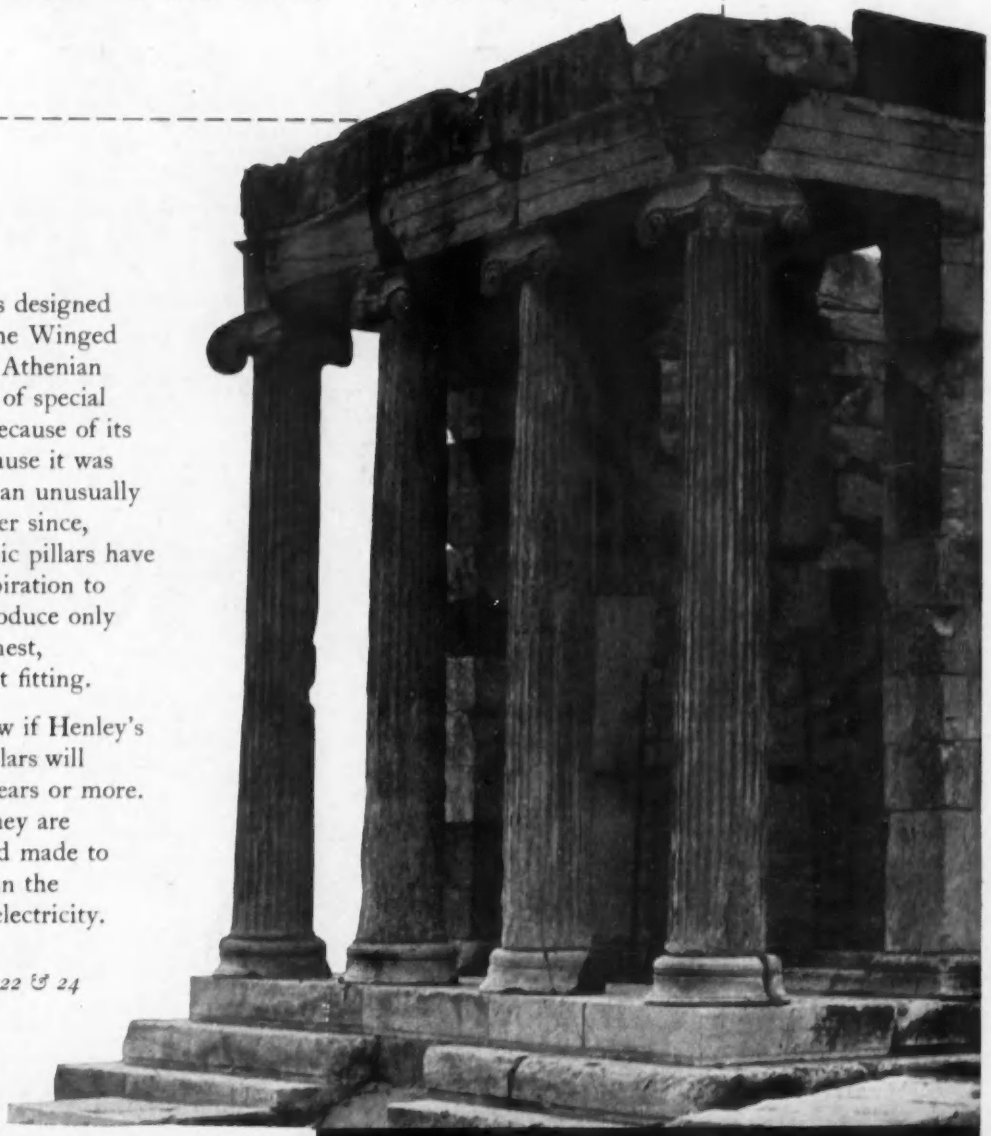
I.E.E. (Scottish). Annual meeting. "Development of High Voltage Cables," J. S. Hastie. Queen's College, Dundee, 7 p.m.

Nottingham Electrical Club. Annual meeting at Reform Club, Victoria St, 7 p.m.

Incorp. Plant Engrs. (Merseyside). "Corrosion of Metals and Methods of Dealing with this Problem," M. Cowan, at Chester.

Incorp. Plant Engrs. (Sheffield). "Illumination." Grand Hotel, 7.30 p.m.

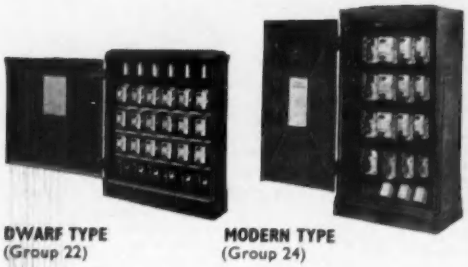
# 2380 YEARS AGO....



. . . . Callicrates designed the temple of the Winged Victory for the Athenian Acropolis. It is of special interest, both because of its beauty and because it was built to occupy an unusually limited site. Ever since, its graceful, Ionic pillars have stood as an inspiration to craftsmen to produce only that which is finest, lasting and most fitting.

We do not know if Henley's Distribution Pillars will last for 2,000 years or more. But we know they are *made* to last, and made to fulfil their role in the distribution of electricity.

*Write for catalogues 22 & 24*



DWARF TYPE (Group 22) MODERN TYPE (Group 24)

**HENLEY**

**DISTRIBUTION PILLARS AND PANELS**

W. T. HENLEY'S TELEGRAPH WORKS COMPANY, LIMITED, 51-53 HATTON GARDEN, LONDON, E.C.1

# Fry's Solders

Fry's solder was the natural choice for plumbing the gland of this isolator to the 0.25 sq. in. 11 kV cable. Fry's ABBEY brand solder quickly softens to the ideal "buttery" consistency.

# Served Here

The pure metal content and balanced composition ensure fast operation and elimination of loss and excessive dripping.

Here, the ABBEY is ladled to the joint for wiping. The smooth flow, the freedom from pinholes and blemishes on cooling, are typical of this top grade solder by Fry's.

**FRY'S** Metal Foundries Limited

**Tandem Works, Merton Abbey, London, S.W. 19 Telephone: MITcham 4023**

*And at MANCHESTER · GLASGOW · BRISTOL & DUBLIN*

# CLASSIFIED ADVERTISEMENTS

Advertisements should be sent to the Classified Advertisement Dept., Electrical Times, Sardinia House, Sardinia Street, London, W.C.2, before 10 a.m. on TUESDAY of the week of issue. Official Displayed Advertisements are charged at 32s. 6d. per inch, and all other classified advertisements at 2s. 6d. per line. Situations Wanted four insertions at twice the single insertion rate. Fee for Box Number and postage on replies 2s.

## TENDERS INVITED

### BENTLEY-WITH-ARKSEY URBAN DISTRICT COUNCIL

SODIUM DISCHARGE LIGHTING
ASKERN ROAD TOLL BAR

TENDERS are invited for the lighting of about 1 mile of Class I road, as follows:
(*a*) Supply of lanterns, lamps and control gear.
(*b*) Supply and erection of columns, fitting and wiring of equipment.
(*c*) Provision of underground cable.

Tenders may be submitted for any or all of the above work, each of which will form a separate contract.

Drawings, Specification, Bills of Quantities and Form of Tender may be obtained from, and the Conditions of Contract inspected at, the office of the Engineer and Surveyor at the address below, on deposit of two guineas, returnable only on receipt of a bona fide tender and the return of the documents.

Sealed tenders in envelopes not bearing any mark indicating the name of the sender, and endorsed "Street Lighting, Askern Rd," must reach the undersigned not later than Tuesday, 31 May, 1955.

The Council does not bind itself to accept the lowest or any tender.

W. H. CARLILE,
Clerk of the Council.

Council Offices,
Cooke St, Bentley,
Nr. Doncaster, Yorks. (R 728)

### CITY OF MANCHESTER

THE Welfare Services Committee invite tenders for ELECTRICAL INSTALLATION required at Home for Aged Persons, Sale Rd, Manchester. Specification and tender form may be obtained from the City Architect, P.O. Box No. 488, Town Hall. Tenders, sealed in endorsed envelopes, must be delivered before 10 a.m. on 23 June, 1955.

PHILIP B. DINGLE,
Town Clerk.

May, 1955. (R 871)

### BOROUGH OF WATFORD

TOWN HALL OFFICE LIGHTING

SCHEMES and tenders are invited from experienced Firms for the supply and installation of improved Lighting in the Offices at the Town Hall, Watford.

Plans of the building and further particulars may be obtained upon application to Mr F. C. Sage, Borough Engineer and Surveyor, Town Hall, Watford, on payment of a deposit of Five Guineas, returnable upon receipt of a bona fide tender not subsequently withdrawn.

The closing date for receipt of Tenders is 2 p.m. on June 16, 1955.

GORDON H. HALL,
Town Clerk.

Town Hall,
Watford.
May, 1955. (R 793)

### BOROUGH OF HESTON AND ISLEWORTH

STREET LIGHTING IMPROVEMENT

TENDERS are invited for the installation of street lighting to Group "A" standard along approximately 2,200 yds of Bath Rd (A3006), Hounslow, including removal of existing columns, supply and erection of 56 steel columns, and supply and fitting of 56 400 W mercury vapour lanterns together with lamps and control gear.

Conditions of Contract and Drawings may be seen at, and, on deposit of £2. 2s. (returnable if a bona fide tender is received and not withdrawn) the Bill of Quantities, Form of Tender and Specification obtained from the Borough Engineer's Department, 88 Lampton Rd, Hounslow. Tenders in sealed envelopes endorsed "Tender—Bath Rd Lighting," but not indicating the sender, must be delivered to me by 10 a.m. on 3 June, 1955.

The Council are not bound to accept any tender.

D. MATHIESON,
Town Clerk.

Town Hall,
Hounslow. (R 807)

### CITY OF WAKEFIELD

STREET LIGHTING, WAKEFIELD
CLASS "A" AND "B" LIGHTING

TENDERS are invited for the supply and erection of 19—25 ft concrete columns mounting 400 W H.P.M.V. lamps enclosed in medium beam angle lanterns and 14—15 ft concrete columns mounting 100 W tungsten lamps in totally enclosed lanterns.

Forms of Tender, Specification and Plans may be obtained on application from the City Engineer, Town Hall, Wakefield.

W. S. DES FORGES,
Town Clerk.

Town Hall,
Wakefield. (R 851)

## APPOINTMENTS VACANT

*Engagement of persons must be made through a Local Labour Office or Scheduled Employment Agency, if the applicant is a man aged 18–64, or a woman aged 18–59; unless the person concerned is excepted or the employment is in a managerial or professional capacity, or is otherwise excepted from the provisions of the Notification of Vacancies Order, 1952.*

### CENTRAL ELECTRICITY AUTHORITY
**Midlands Division**

APPLICATIONS are invited for the position of ASSISTANT SHIFT CHARGE ENGINEER at Ocker Hill Power Station. N.J.B. service conditions, superannuable appointment, salary within Schedule A of the Agreement, Grade F9, commencing at £675 per annum.

Applicants should have received a sound technical training and power station practical experience in the operation and maintenance of steam generating plant and main switchgear. Appropriate technical qualifications will be an advantage.

Apply, quoting Vacancy No. 952MD, on form A.E.6 available from the Establishments Officer, 53 Wake Green Rd, Moseley, Birmingham 13, by 4 June, 1955. (R 845)

### COUNTY OF LINCOLN—PARTS OF KESTEVEN
**Education Committee**

GRANTHAM COLLEGE FOR FURTHER EDUCATION

Principal: G. F. Johnson, M.ED., B.SC., M.I.MECH.E., A.M.I.MAR.E., F.R.S.A.

APPLICATIONS are invited for the appointment as a full-time TEACHER of electrical engineering in the Engineering Department. Practical experience in Electrical Supply, Distribution or Contracting is essential. Candidates should be able to offer Electrical Installation and Electro-Technology as main subjects.

The salary offered is according to the Burnham Technical Scale A.

Applicants should hold some recognised degree, diploma or other professional qualification. Ability to assist with general college activities will be a recommendation.

The appointment will date from 1 Sept., 1955. Application forms, and other particulars, may be obtained by sending a stamped-addressed envelope to the Principal. Completed forms should be forwarded immediately, and in any case not later than two weeks after the appearance of this advertisement, to the Principal, Grantham College for Further Education, Avenue Rd, Grantham.

T. W. P. GOLBY, B.SC., PH.D.,
Director of Education.

County Offices,
Sleaford,
Lincs. (R 841)

### CENTRAL ELECTRICITY AUTHORITY
**East Midlands Division**

APPLICATIONS are invited for the position of STATION CHEMIST at Staythorpe Generating Station, near Newark, Notts.

Candidates should be Associates of the Royal Institute of Chemistry or hold an equivalent qualification and must have had previous experience in a position of responsibility in a power station laboratory.

Candidates should be familiar with the analysis of coal, oil and water and with the interpretation and application of the analytical results. Experience with problems arising from high pressure, high temperature operation and with their solution is desirable.

Salary in accordance with Class J, Grade 7 (£900/£975 per annum) of the National Joint Board Agreement and the position is pensionable within the provisions of the Central Electricity Authority and Area Boards Superannuation Scheme.

Applications should be submitted on the official form A.E.6/ACT which may be obtained from the Divisional Establishments Officer, Central Electricity Authority, P.O. Box 25, Barker Gate, Nottingham, and should be returned to the undersigned by 7 June 1955. Please quote Vacancy No. 78/55/ET.

L. F. JEFFREY,
Divisional Controller.

13 May, 1955. (R 840)

### COLLEGE OF TECHNOLOGY, BIRMINGHAM
DEPARTMENT OF ELECTRICAL ENGINEERING

APPLICATIONS are invited for the post of SENIOR LECTURER.

Applicants should be Chartered Electrical Engineers with Honours Degree in Electrical Engineering or its equivalent, and should have practical experience on the Heavy Side of Electrical Engineering either in the field of Electrical Machine Design, or Power System Network Analysis.

Salary will be in accordance with the Burnham (Further Education) Scale for Senior Lecturers (Men) £1,065 x £25—£1,215.

Further particulars and form of application may be obtained from the Registrar, College of Technology, Suffolk St, Birmingham 1, on receipt of stamped addressed foolscap envelope. Completed forms should be returned to him not later than 2 weeks after the appearance of this advertisement.

K. R. PILLING,
Clerk to the Governing Body.
(R 817)

## NORTH OF SCOTLAND HYDRO-ELECTRIC BOARD

APPLICATIONS are invited for the position of TECHNICAL ASSISTANT in the North Caledonia Area Headquarters at Elgin. Preference will be given to applicants with experience in commissioning and testing protection equipment up to and including 132 kV. Knowledge of power line carrier protection and radio communication circuits would be an advantage. Salary N.J.B. F/5, £840 x £20—£900 per annum. Superannuation Scheme applicable. Applications, stating age, qualifications and experience, to be forwarded to the Area Manager, West Villa, Elgin, Morayshire, by 6 June, 1955. (R 848)

## YORKSHIRE ELECTRICITY BOARD

### No. 5 (Wakefield) Sub-Area

Wakefield District

THIRD ASSISTANT DISTRICT ENGINEER

APPLICANTS must have had a sound practical training and experience in the construction, operation and maintenance of H.V. and M.V. overhead and underground distribution networks, substation plant and ancillary equipment.

Applicants should hold a current driving licence, be prepared to reside in the district and undertake standby duties.

Preference will be given to those who are Corporate Members of the Institution of Electrical Engineers or who hold equivalent qualifications.

Salary—N.J.B. Class F, Grade 9, £675/£15/£720 per annum.

Applications, giving full details of age, qualifications and experience, together with the names of two referees, should be forwarded to the Manager, No. 5 (Wakefield) Sub-Area, Yorkshire Electricity Board, 1a Denby Dale Rd, Wakefield, not later than 2 June, 1955.

### No. 2 (Huddersfield) Sub-Area

Huddersfield District

FOURTH ASSISTANT DISTRICT ENGINEERS (2 POSTS)

Applicants should be Graduate Members of the Institution of Electrical Engineers, or possess equivalent qualifications, and have had experience in the design, construction, operation and maintenance of overhead and underground distribution systems, substation plant and ancillary equipment.

Salary—N.J.B. Class H, Grade 11, £675/£15/£720 per annum.

Applications, giving full details of age, qualifications and experience, together with the names of two referees, should be forwarded to the Manager, No. 2 (Huddersfield) Sub-Area, Yorkshire Electricity Board, Market St, Huddersfield, not later than 2 June, 1955.

### No. 1 (Bradford) Sub-Area

Otley District

GENERAL ASSISTANT DISTRICT ENGINEERS (2 POSTS)

Applicants should hold the Higher National Certificate in Electrical Engineering or acceptable equivalent qualifications, and have had training and experience in the construction, operation and maintenance of high voltage overhead and underground distribution systems.

Salary—N.J.B. Class E, Grade 13, £475/£15/£520 per annum.

Applications, giving full details of age, qualifications and experience, together with the names of two referees, should be forwarded to the Manager, No. 1 (Bradford) Sub-Area, Yorkshire Electricity Board, 45-53 Sunbridge Rd, Bradford, not later than 2 June, 1955.

### Head Office

Chief Engineer's Department

ENGINEERING DRAUGHTSMAN (CIVIL)

Applicants should have experience in preparing drawings of Civil Engineering work, preferably with some experience in detailing reinforced concrete.

Salary—N.J.B. Schedule D, Grade 6, £510/£20/£630 per annum.

Applications, giving full details of age, qualifications and experience, together with the names of two referees, should be forwarded to the Secretary, Head Office, Yorkshire Electricity Board, Scarcroft, Leeds, not later than 2 June, 1955. (R 850)

## MIDLANDS ELECTRICITY BOARD

ASSISTANT (Female) required at the Board's Training Centre near Bromsgrove. Duties will include demonstration and instruction to staff and trainees in the use and selling of appliances, and administrative work in connection with the operation of the Training Centre. Domestic Science training and experience in Demonstrators duties required. Salary £585/£645 per annum (N.J.C. Grade 3). Superannuable. Apply, in writing, stating age, education, training, qualifications, experience, present position and salary to the Secretary (Ref.: FWC), Midlands Electricity Board, Mucklow Hill, Halesowen.

A. STEPHENS,
Secretary.
(R 852)

## CENTRAL ELECTRICITY AUTHORITY

### Southern Division

APPLICATIONS are invited for the following posts:

CHEMIST
S/13.661

There is a vacancy for a chemist on the staff of the Division. In the first instance the successful candidate will be required to work for an indefinite period as Station Chemist at Poole Generating Station at a salary of £900 (N.J.B. Schedule A, Grade J.7).

On the termination of his duties at Poole, the person appointed will be transferred to the staff of the Divisional Chemist at the Headquarters laboratory, Portsmouth, at a salary in accordance with N.J.B. Schedule C, Class AX, Grade 3 (£875/£1,000) unless other station vacancies then available are preferred.

Applicants should be fully qualified industrial chemists with practical experience of fuel, water and oil testing. A knowledge of boiler chemistry for high steam pressures and temperatures will be an advantage.

FOURTH ASSISTANT ENGINEER
TRANSMISSION DEPARTMENT
S/13.662

Applicants should have had training and experience of H.V. and L.V. supply systems and preferably should have received a works training on high voltage switchgear and transformers. Previous experience of the erection of either overhead lines, cables or substations, or transmission maintenance work will be an advantage.

Applicants should possess a Higher National certificate or its equivalent and preferably possess or be studying for qualifications leading to corporate membership of an appropriate professional institution.

Salary N.J.B. AX/CX Grade 6, £600/£765.

Special application forms for each post, obtainable from P. D. A. Oliver, Divisional Secretary, 111 High St, Portsmouth, should be returned by 1 June, 1955. Please quote reference E.T. (R 853)

## TECHNICAL INSTRUCTOR (Electrical)

required by the Government of the Western Region, Nigeria, for two tours of 18/24 months or three tours of 10/12 months. Option of appointment either (*a*) on agreement with prospect of permanent and pensionable employment in salary scale (including expatriation pay) £750 rising to £1,175 a year or (*b*) on temporary contract in salary scale (including expatriation pay) £807 rising to £1,269 a year with a gratuity (resettlement grant) at rate of £100/£150 a year. Outfit allowance £60. Free passages for officer and wife. Assistance towards cost of children's passages or grant up to £150 annually for maintenance in U.K. Liberal leave on full salary. Candidates must have served an apprenticeship and have had good subsequent experience in electrical installation and practice. They must hold a Full Technological or Final C. and G. Certificate in Electrical Installation work or Electrical Engineering Practice. Write to the Crown Agents, 4 Millbank, London, S.W.1. State age, name in block letters, full qualifications and experience and quote M2A/40808/EE. (R 798)

## NORTH WESTERN ELECTRICITY BOARD

GENERAL ASSISTANT ENGINEERS (JUNIOR TESTING ASSISTANTS) SUB-AREA TECHNICAL ENGINEER'S DEPARTMENT, MANCHESTER

APPLICANTS should have had experience of testing meters, instruments and protective equipment and should hold the H.N.C. or O.N.C. in Electrical Engineering.

Salary Scale: £475 x £15—£520 per annum, Grade L.19, N.J.B. Conditions.

Applications to Sub-Area Secretary, No. 1 Sub-Area, The North Western Electricity Board, Town Hall, Manchester, P.O. Box 493, by 28 May, 1955.

THIRD ASSISTANT ENGINEER (TESTING) HILL TOP TESTING STATION, WALKDEN

Applicants should have had a wide experience of testing work, including testing of meters in a Class "A" Testing Station, polyphase and summation metering equipment, and protective gear in the laboratory and on site.

Preference given to applicants who are Graduate or Corporate Members of the Institution of Electrical Engineers.

Salary Scale: £840 x £20—£900 per annum, Grade L.10, N.J.B. Conditions.

Applications to Sub-Area Manager, No. 2 Sub-Area, The North Western Electricity Board, 2 St. George's Rd, Bolton, by 28 May, 1955.

THIRD ASSISTANT ENGINEER (SYSTEM PLANNING) SUB-AREA ENGINEER'S DEPARTMENT, KENDAL

Duties will include assistance in the planning of H.V. and L.V. networks, including the design and application of protective gear and the specification of H.V. switchgear.

Experience in the calculation of system load flows and fault levels is essential, and applicants should preferably hold the H.N.C. (or equivalent) in Electrical Engineering. Some operational experience in the Electricity Supply Industry is desirable.

Salary Scale: £755 x £15—£800 per annum, Grade J.10, N.J.B. Conditions.

Applications to Sub-Area Manager, No. 6 Sub-Area, The North Western Electricity Board, Castle Green, Kendal, by 28 May, 1955. (R 815)

## SOUTH WALES ELECTRICITY BOARD

require ASSISTANT ENGINEER (General) District 463/464 (Abergavenny), Eastern Sub-Area.

Salary—Class D, Grade 8 (£635/£680) of the N.J.B. Schedule.

Applications stating age, present position, salary, qualifications, experience and three referees, should be addressed to the Secretary (Establishment Section) St. Mellons, to arrive by 28 May, 1955.

D. G. DODDS,
Secretary.
St. Mellons,
Cardiff. (R 847)

## CENTRAL ELECTRICITY AUTHORITY

### Eastern Division

APPLICATIONS are invited for the following appointment:

GENERAL ASSISTANT ENGINEER
BRIMSDOWN GENERATING STATION

Salary Class J, Grade 17, £475 x £15—£520 per annum plus London Weighting, to Class J, Grade 14, £595 x £15—£640 per annum plus London Weighting, depending on duties and responsibilities.

Duties, including periods of Shift Duty, involve assisting in the Electrical Control Room and experience in the technical operation of electrical, boiler house and turbine house plant, testing, etc., and provide a suitable basis for promotion to higher technical grades.

Previous experience in a Generating Station and/or technical training to the standard of the Ordinary National Certificate or its equivalent will be an advantage.

Applications stating age, qualifications, present position and previous experience should be sent to the Controller, Central Electricity Authority, Eastern Division, Northmet House, Southgate, N.14, by 28 May, 1955.

W. N. C. CLINCH,
Controller.
(R 819)

## SOUTH OF SCOTLAND ELECTRICITY BOARD
### Ayrshire Area

THIRD ASSISTANT DISTRICT ENGINEERS

APPLICATIONS are invited for appointments as THIRD ASSISTANT DISTRICT ENGINEERS in the undernoted Districts.

The salaries and conditions of service will be in accordance with the National Joint Board Agreement.

| *District* | *Classification and Grading* | *Salary* |
|---|---|---|
| Kilmarnock | E—9 | £635/£680 per annum |
| Ayr | E—9 | £635/£680 per annum |
| Ardrossan | E—9 | £635/£680 per annum |
| Mauchline | D—9 | £595/£640 per annum |

Applicants should preferably be Graduates of the Institution of Electrical Engineers or hold equivalent qualifications. They should have had a sound engineering training with experience in the operation and maintenance of Distribution Systems up to and including 33 kV.

The successful candidates will require to reside within reasonable distance of their respective District Offices.

Application Forms, which may be obtained from the undersigned or any other Area Manager, should indicate the District preferred and be lodged with me not later than 4 June, 1955.

A. E. ROOTS,
Manager.

Greenholm St,
Kilmarnock.
11 May, 1955. (R 820)

## CENTRAL ELECTRICITY AUTHORITY
### London Division

APPLICATIONS are invited for the following superannuable posts. Conditions of service in accordance with N.J.B. Agreement, Schedule A or C. Salary includes London Allowance. Qualifications entitling to Graduate Membership of the I.E.E. or I.Mech.E. for post (*a*) and Corporate Membership for posts (*b*) an advantage.

(*b*) STATION SUPERINTENDENT
BANKSIDE GENERATING STATION
Vacancy No. 55/359

Applicants should have had a wide experience of Power Station operation, maintenance and administration, and should have a lively sense of responsibility in Management/Employee relations. Salary—N.J.M. and H.E. Scale 2=£1,350/£1,500 per annum.

(*b*) DEPUTY STATION SUPERINTENDENT
DEPTFORD WEST GENERATING STATION
Vacancy No. 55/360

Candidates should have received a sound technical and practical training and have experience in the operation and maintenance of generating plant, cost and efficiency. A knowledge of the Agreements covering personnel necessary, with a successful record in labour relations. Salary—Class J, Grade 3=£1,245 per annum.

(*b*) STATION SUPERINTENDENT
ST. MARYLEBONE GENERATING STATION
Vacancy No. 55/361

Applicants should have had a wide experience of Power Station operation, maintenance and administration, and should have a lively sense of responsibility in Management/Employee relations. Salary—Class E, Grade 1=£1,085 per annum.

(*a*) GENERAL ASSISTANT ENGINEERS
TECHNICAL DEPARTMENT, DIVISIONAL H.Q.
Vacancy No. 55/362

Candidates should possess good technical qualifications, preferably a B.SC. Degree in Electrical Engineering, or its equivalent. Works training on heavy electrical plant, communications equipment or instrument and meter manufacture and testing will be considered an advantage. Salary—Class AX/EX, Grade 7=£500/£661. 10s. per annum.

Applications, quoting vacancy number, may be made on form obtainable from Divisional Secretary, Central Electricity Authority, London Division, P.O. Box 136, Generation House, Great Portland St, W.1, and be received within 14 days of this advertisement. (R 822)

## CENTRAL ELECTRICITY AUTHORITY
### North West, Merseyside & N. Wales Division

VACANCY No. E.129/163/T.—SHIFT CHARGE ENGINEER, Roosecote Generating Station, Barrow. Salary £790/£850 (G.7).

Vacancy No. E.129/166/T.—ASSISTANT SHIFT CHARGE ENGINEER, Connah's Quay Generating Station. Salary £715/£760 (G.9).

Vacancy No. E.129/167/T.—MAINTENANCE ENGINEER (Elec.), Westwood Generating Station. Salary £840/£900 (G.6). Previous applicants for vacancies Nos. 80 and 115 need not re-apply.

Applications to Divisional Secretary, Central Electricity House, 825 Wilmslow Rd, Manchester 20, before 28 May. Quote vacancy No. (R 813)

## ELECTRICAL SUPERVISORS
### Nigerian Ports Authority

APPLICATIONS are invited for posts of ELECTRICAL SUPERVISOR in the Chief Engineer's Department of the NIGERIAN PORTS AUTHORITY. The Authority was recently created as a Public Corporation and offers good prospects.

Applicants must have had extensive experience in the maintenance and repair of A.C. power transmission and distribution, workshop machinery, cranes and traction motors. Those appointed will be required to supervise the maintenance of electrical machinery in shipyards, on quay cranes and diesel-electric locomotives. Minimum qualification is the City and Guilds Final in Electrical Engineering Practice, or equivalent.

The Authority's interests include the operation of all ports and waterways in Nigeria. The successful candidates will, therefore, be required to undertake periodical visits to its various stations throughout the country.

The salary will be at the consolidated rate of £1,450 per annum, which figure includes an element for Overseas pay.

Appointment will be for one tour in the first instance. Thereafter, subject to satisfactory service, employment will be offered on a permanent basis and officers will be eligible for membership of such Pension or Provident Scheme as the Authority may introduce. This will be on a non-contributory basis. It may be possible to preserve existing pension rights. The maximum tour is 15 months, but normally 10-12 months. Free first class return passages for Officer and wife and assistance towards cost of, up to two, children's passages or grant up to £150 annually towards maintenance in U.K. Partly furnished quarters provided at a rental of 10% of salary (maximum £150 a year). Outfit allowance £60. Grant of £100 to meet cost of soft furnishings, paid on arrival. Leave on full salary at rate of 7 days for each month's service. Free medical services. Car allowances payable and loans for car purchase in approved cases. Write to the Crown Agents, 4 Millbank, London, S.W.1. State age, name in block letters, full qualifications and experience and quote M2A/40796/EE. The closing date for applications is 31 May. (R 809)

## SOUTH WESTERN ELECTRICITY BOARD

THIRD ASSISTANT DISTRICT ENGINEER (CONSTRUCTION)—WESTON

SALARY N.J.B. Class F (subject to confirmation), Grade 9—£675/£720 per annum.

The duties include all types of construction work including H.V. and L.V. overhead lines and underground cables, preparing material schedules, specifications, reports, statistics, phasing of work and supply of materials, maintenance and progress records.

Candidates who should possess at least the H.N.C., may be required to undertake standby duty.

Application forms obtainable from the District Manager, 19 Waterloo St, Weston, should be returned by 31 May, 1955. (R 843)

## MERSEYSIDE AND NORTH WALES ELECTRICITY BOARD

APPLICATIONS are invited for the following appointments, which are superannuable and subject to medical examination. Applicants should preferably possess the technical qualifications to enable them to become Chartered Electrical Engineers.

SECTION ENGINEER in the Warrington District. Salary £755/£800 per annum (N.J.B. F/7).

Applicants should have had experience in H.T. and L.T. overhead and underground distribution work. The successful applicant may be required to undertake standby duties.

Application forms obtainable from the Manager, No. 2 Sub-Area, Sandiway Hse, near Northwich, Cheshire. Closing date: 31 May, 1955.

SECTION ENGINEER in the Oswestry District, based on Whitchurch in the No. 4 Sub-Area. Salary £715/£760 per annum (N.J.B. E/7).

Applicants should have experience in all branches of work associated with design, construction, and operation of E.H.T., H.T., and L.T. overhead and underground distribution systems, including indoor and outdoor substation equipment.

Application forms obtainable from the Manager, No. 4 Sub-Area, Electricity Hse, Rhostyllen, near Wrexham. Closing date: 31 May, 1955. (R 790)

## SOUTH EASTERN ELECTRICITY BOARD

DISTRICT ENGINEER
Woking District

SALARY £900/£975 per annum under N.J.B. Class E, Grade 3. Superannuable. It is probable that the N.J.B. classification of Woking District will rise to Class F in twelve months' time. Applicants, preferably Corporate Members of the I.E.E., should have experience in E.H.V. and L.V. distribution design and practice, together with the ability to organise and control the activities of a district distribution department.

Applications naming 2 referees, on forms from C. W. Hughes, B.SC., M.I.E.E., Surrey Manager, SEEBoard, Rough Rew, Horsham Rd, Dorking, by 1 June, 1955.

JOINTER (EXTRA HIGH TENSION)
Woking District

Wages 4s. 1d. per hour for 44-hr, 5-day week under N.J.I.C. Agreement.

Applications, naming 2 referees, on forms from J. C. Poole, A.M.I.E.E., District Manager, SEEBoard, 4 Chobham Rd, Woking, by 1 June, 1955.

A. L. BURNELL,
Secretary.
(R 838)

## THE UNITED KINGDOM ATOMIC ENERGY AUTHORITY
### Aldermaston, Berks

requires an EXPERIMENTAL OFFICER to be responsible for the design of transformers, chokes and R.F. coils for electronic equipment for instrumentation and equipment design departments. The minimum qualification is H.S.C.(SCIENCE) or equivalent, but a H.N.C. in Electrical Engineering is desirable. Applicants should have experience of small power (less than ½ kW), transformer and choke design and R.F. and I.F. coil design with particular reference to service climatic conditions. A knowledge of pulse transformer design technique would be an advantage. Salary £775/£945 per annum (male) minimum age 26.

The successful applicant will be required to join the Authority's contributory superannuation scheme.

Housing accommodation will be available within a reasonable period for married officers who live outside the radius of the Establishment's transport facilities or alternatively the Authority may be able to assist successful applicants in the purchase of a house. During this period lodging allowance may be payable.

Requests for application forms by post card to Senior Recruitment Officer, A.W.R.E., Aldermaston, Berks. Quote reference 646/WGE/49. (R 808)

### CITY OF BIRMINGHAM PUBLIC WORKS DEPARTMENT

APPLICATIONS are invited for the following posts in the Mechanical and Public Lighting Section:

(a) CHIEF ASSISTANT (Electrical). Grade A.P.T. VI (£825/£1,000 per annum).

(b) ELECTRICAL ENGINEERING ASSISTANT. Grade A.P.T. IV (£675/£825 per annum).

Commencing salary in accordance with qualifications and experience.

Applicants for the above posts should be Associate Members of the Institution of Electrical Engineers or hold equivalent qualifications. They should have had considerable experience in the design, specification and supervision of contracts for electric lighting and power installations in large public buildings.

The posts are permanent, superannuable, subject to a medical examination and to one month's notice on either side.

Applications endorsed with the description of the post applied for stating qualifications, age and experience, together with the names of two persons to whom reference can be made should reach the undersigned not later than 11 June, 1955.

Canvassing disqualifies.

HERBERT J. MANZONI,
City Engineer and Surveyor.

Civic Centre,
Birmingham, 1. (R 792)

### CENTRAL ELECTRICITY AUTHORITY
#### South Eastern Division

STATION SHIFT CONTROL ENGINEER—BRIGHTON "A" STATION

APPLICANTS who should preferably possess H.N.C. in Electrical Engineering, must have had experience in the operation and control of turbo-generators and in Control Room duties connected with interconnected generating systems and E.H.T. feeder network. N.J.B. Conditions of Service and salary. Class H, Grade 10, £715 x £15 to £760 per annum.

Applications giving details of education, present position, experience, etc., should be sent to the Station Superintendent, Brighton Power Station, Portslade-by-Sea, Sussex, to arrive by 28 May. (R 812)

### SOUTH WALES ELECTRICITY BOARD

require

(a) THIRD ASSISTANT ENGINEER (Planning).

(b) THIRD ASSISTANT ENGINEER (Substations)

in the Western Sub-Area of the Board, Tenby.

Salary—Class G, Grade 10 (£675/£720) of the N.J.B. Schedule.

Applications stating age, present position, salary, qualifications, experience and three referees, should be addressed to the Secretary (Establishments Section), St. Mellons, to arrive by 28 May, 1955.

D. G. DODDS,
Secretary.

St. Mellons,
Cardiff. (R 846)

### SOUTHERN ELECTRICITY BOARD

SENIOR DRAUGHTSMAN

NO. 3 (Portsmouth) Sub-Area. Salary N.J.B. Schedule D, Grade 5 (£640/£740 per annum). N.J.B. Conditions of Service.

The successful applicant will be responsible to the Sub-Area Civil Engineer for design work, preparation of drawings and making calculations; candidates should have knowledge of building construction, steel work and reinforced concrete structures. Experience in an Architect's office would be an advantage.

The successful candidate for the above appointment will be required to contribute to the C.E.A. and Area Boards' Superannuation Scheme, if eligible.

Applications on forms obtainable from the Sub-Area Secretary, Lower Drayton Lane, Cosham, Portsmouth, and returned to him in envelopes suitably endorsed, not later than 3 June, 1955. (R 849)

### EASTERN ELECTRICITY BOARD

APPLICATIONS are invited for the following appointments. The successful candidates will be required to contribute to a superannuation scheme and may be required to undergo a medical examination.

#### Chilterns Sub-Area

Luton District
SENIOR DEMONSTRATOR
63/55.N

Candidates should hold the E.A.W. Certificate and Diploma and be fully experienced in the use, demonstration and sale of all domestic electrical appliances. Previous experience in the organisation of public demonstrations and lecturing on domestic electrical subjects is essential.

Salary—N.J.C. Grade 2 (£525 x £20—£585).

Apply within 14 days to the District Manager, Eastern Electricity Board, 487 Dunstable Rd, Luton, Beds.

Northwood District
THIRD ASSISTANT ENGINEER
90/55.R

Candidates should have had a sound technical training and suitable experience in the construction, operation and maintenance of H.V. and L.V. underground systems including substations.

Salary—N.J.B. Class F, Grade 9 (£675/£720) plus London Allowance.

Apply within 14 days to the District Manager, Eastern Electricity Board, 1 Love Lane, Pinner, Middlesex.

#### Northmet Sub-Area

Enfield District
FOURTH ASSISTANT ENGINEER (REF. 535)
91/55.R

Candidates should have had a sound technical training and suitable experience in the construction, operation and maintenance of H.V. and L.V. distribution systems including substations.

Salary—N.J.B. Class F, Grade 11 (£595/£640) plus London Allowance.

Apply within 14 days to the District Manager, Eastern Electricity Board, 40 Church St, Enfield, Middlesex.

St. Albans District
SALES REPRESENTATIVE (REF. 554)
92/55.N

The duties will consist of advising consumers on commercial matters associated with supply, tariffs and apparatus sales, in accordance with the N.J.C. Agreement.

Salary—N.J.C. Grade 1 (£425 x £20—£525).

Apply within 14 days to the District Manager, Eastern Electricity Board, 107 St. Peters St, St. Albans, Herts.

Tottenham District
THIRD ASSISTANT ENGINEER
93/55.R

Candidates should have had a sound technical training and suitable experience in the construction, operation and maintenance of H.V. and L.V. distribution systems including substations.

Salary—N.J.B. Class E, Grade 9 (£635/£680) plus London Allowance.

Apply within 14 days to the District Manager, Eastern Electricity Board, 312 High Rd, Tottenham, London, N.15. (R 854)

### CENTRAL ELECTRICITY AUTHORITY
#### North Eastern Division

APPLICATIONS are invited for the appointment of ASSISTANT SHIFT CHARGE ENGINEER at Scarborough Power Station.

Applicants should have served a recognised engineering apprenticeship, and should possess technical qualifications. Some experience in electricity generation would be an advantage.

The salary for the appointment (which is superannuable) will be in accordance with the National Joint Board Agreement, Schedule A, Grade 9, Class C (£555/£600 per annum).

Forms of application may be obtained from Divisional Establishments Officer, Central Electricity Authority, North Eastern Division, Carliol House, Newcastle upon Tyne, to whom they should be returned to arrive not later than 1 June, 1955. (R 844)

### SOUTH WESTERN ELECTRICITY BOARD

1. DEMONSTRATOR—BRISTOL NORTH COMMERCIAL DISTRICT
2. DEMONSTRATOR—EAST CORNWALL DISTRICT (LISKEARD)

SALARY N.J.C., Grade 1—£425/£525 per annum.

Duties include public demonstrations of cooking and electrical appliances, and advice generally on their use. Candidates should possess recognised domestic science qualification, with preferably E.A.W. Electrical Housecraft Certificate.

Application forms obtainable for post 1 from the District Manager, 110 Whiteladies Rd, Bristol 8, and for post 2 from the Manager, Cornwall Sub-Area, Pool, Redruth, Cornwall, should be returned by 1 June, 1955. (R 837)

### CENTRAL ELECTRICITY AUTHORITY
#### North Eastern Division

APPLICATIONS are invited for the appointments of SHIFT OPERATING ENGINEERS at Stella North Power Station.

Applicants should possess a Higher National Certificate or equivalent qualifications.

The salary for these appointments (which are superannuable) will be in accordance with the National Joint Board Agreement, Schedule A, Grade 10, Class J (£755/£800 per annum).

Forms of application may be obtained from Divisional Establishments Officer, Central Electricity Authority, North Eastern Division, Carliol House, Newcastle upon Tyne 1, to whom they should be returned to arrive not later than 31 May, 1955. (R 821)

### LONDON ELECTRICITY BOARD

DEMONSTRATORS (FEMALE)

APPLICATIONS are invited for the above positions at Hampstead, N.W.3, and Willesden, N.W.2.

Applicants should be suitably qualified, holding the E.A.W. or other approved certificate including electrical housecraft and have experience in conducting demonstrations. They should also be experienced in advising on the selection and use of domestic electrical appliances. The posts are graded within the National Joint Council agreement (Administrative and Clerical Grades) as Grade 1, i.e. £425/£525 per annum, plus the appropriate London Area Allowance.

Application forms obtainable from Personnel Officer, 46/7 New Broad St, London, E.C.2, to be returned completed by 4 June, 1955. Please enclose addressed envelope and quote ref.: V/1922/41/T. (R 814)

### PORT OF LONDON AUTHORITY

THE Port of London Authority invite applications for the position of ASSISTANT ENGINEER (Electrical) at a salary (inclusive of Pay Supplement) of £995 rising by annual increments to £1,356 per annum.

Candidates, who must be British subjects and Corporate Members of the Institution of Electrical Engineers, should have served a recognised apprenticeship with one of the major electrical manufacturing firms and should have experience in the specification, installation, operation and maintenance of the electrical equipment of a dock or harbour undertaking or heavy industrial organisation, including H.V. and L.V. distribution systems, rectifying plant, A.C. and D.C. cranes and pumping plant, large lighting schemes and V.H.F. radio-telephony. Preference will be given to candidates not over 40 years of age.

The successful applicant will be required to become a member of the Port Authority's contributory superannuation scheme. In certain cases existing pensionable service is transferable.

Application forms may be obtained from the Establishment Officer, Port of London Authority, Trinity Sq, London, E.C.3.

E. S. BIRCH,
Secretary.
(R 730)

## CENTRAL ELECTRICITY AUTHORITY
### South Wales Division

APPLICATIONS are invited for superannuable N.J.B. appointment of FOURTH ASSISTANT ENGINEER in the Telecommunications Section, Technical Department, Divisional Headquarters.

Salary: AX/DX.6 — £600/£785 per annum.

Possession of H.N.C. (Elec.) or equivalent qualification desirable. Experience in maintenance and/or construction of automatic and line transmission telephone apparatus.

The successful applicant will be based ultimately at Swansea and his duties will be concerned with the Authority's telecommunication system in the West Wales area.

Application forms obtainable from Secretary, South Wales Division, Central Electricity Authority, Twyn-y-Fedwen Rd, Gabalfa, Cardiff, to be returned by 10 June, 1955. (R 867)

## UGANDA ELECTRICITY BOARD
APPOINTMENT OF COMMERCIAL ENGINEER

APPLICATIONS are invited for the new post on the permanent staff of Commercial Engineer with headquarters at Kampala, Uganda. The successful candidate will be required to work with energy, imagination and skill to develop and extend the use of electricity to all classes of the community in Uganda where ample power is available. Experience with a progressive electricity undertaking and sound commercial judgment are necessary. An expert knowledge of tariffs and an appreciation of the value of good public relations are essential. The commencing salary to be decided according to qualifications and experience will be within the scale £1,700 x £100 to £2,400 per annum.

Free partly furnished accommodation will be provided and free medical and dental treatment for employee and family. Free passages to and from Uganda up to the equivalent of three adult passages. Kampala has a pleasant and healthy climate and taxation is lower than in the United Kingdom.

Service will in the first instance be on a three-year contract allowing for vacation leave at the rate of five days per month of service on full salary. Up to thirty-six days local leave may be granted during the period of contract.

The person appointed will be required to enter either the Provident or Pension Scheme of the Board.

The successful candidate will be required to produce a medical certificate of fitness and to sign a contract of service. A copy of this contract and other information may be obtained from the Board's London Representative, 27 Regent St, S.W.1. Application forms, obtainable from the London Representative should be returned in envelopes marked "Commercial Engineer," not later than 13 June to Sir Charles Westlake, Chairman, Uganda Electricity Board, at the above address.

E. H. WILSON,
Secretary.
(R 816)

AMENDED ADVERTISEMENT

## CENTRAL ELECTRICITY AUTHORITY
### South Eastern Division

CROYDON "A" AND "B" POWER STATIONS

ASSISTANT ENGINEER (Works Office Co-ordination), Class K, Grade 7, £975/£1,050 per annum, plus 5% London Allowance. The position requires a person having foresight with an analytical mind, coupled with initiative to co-ordinate the operation and maintenance activities of a modern Power Station. Applicants should have experience of both these activities and preferably possess membership of either the Institution of Mechanical or Electrical Engineers.

N.J.B. Conditions of Service. Applications giving details of education, present position, experience, etc., should be sent to the Station Superintendent, Croydon "B" Power Station, Beddington Farm Rd, Croydon, Surrey, to arrive by 28 May. (R 811)

## LONDON ELECTRICITY BOARD
ENGINEERING DRAUGHTSMAN

APPLICATIONS are invited for the above position in the Design and Planning Branch of the St. Marylebone/St. Pancras District.

Applicants should have had a good general and technical education in electrical engineering and building construction, and experience in a mains records office dealing with systems of all voltages up to 11 kV.

The post is graded under Schedule D of the National Joint Board agreement as Grade 6—£535 10s. to £661 10s. per annum, inclusive of London Allowance.

Application forms obtainable from Personnel Officer, 46/7 New Broad St, London, E.C.2, to be returned completed by 28 May, 1955. Please enclose addressed envelope and quote ref.: V/1967/T. (R 839)

## CENTRAL ELECTRICITY AUTHORITY
### East Midlands Division

APPLICATIONS are invited for the following positions within the Division:

GENERAL ASSISTANT ENGINEER (CHEMIST)
STAYTHORPE POWER STATION,
NEAR NEWARK
Vacancy No. 74/55/ET

Candidates must have had a sound technical training and some previous laboratory experience, and should hold the Ordinary National Certificate in Chemistry (or equivalent qualifications).

Salary will be within Class J, Grade 16 £515 x £15—£560 per annum) of the National Joint Board Agreement.

Closing date for receipt of applications: 30 May, 1955.

GENERAL ASSISTANT ENGINEERS
STAYTHORPE POWER STATION
Vacancy No. 75/55/ET

General Assistant Engineers are required at Staythorpe Power Station where suitable young engineers will be given opportunity to obtain operating and maintenance experience in the various sections of this large Generating Station operating at 900°/900 lb sq in. steam conditions.

Preference will be given to candidates who hold the Higher National Certificate, or who are at present pursuing a course of study with the object of obtaining this or a similar qualification.

Salary will be within Class J, Grade 16 (£515 x £15—£560 per annum) of the National Joint Board Agreement.

Closing date for receipt of applications: 30 May, 1955.

ASSISTANT SHIFT CHARGE ENGINEER
DRAKELOW POWER STATION
Vacancy No. 76/55/ET

Applicants must have technical qualifications up to Higher National Certificate Standard and have received a sound engineering training followed by operating experience with large capacity High Pressure Plant, preferably in conjunction with P.F. Boilers.

Salary for this appointment will be within Class J, Grade 9 £790 x £20—£850 per annum) of the National Joint Board Agreement.

Closing date for receipt of applications: 7 June, 1955.

STATION SUPERINTENDENT, ST. SWITHIN'S
GENERATING STATION, LINCOLN
Vacancy No. 77/55/ET

Applications are invited for the position of Power Station Superintendent at Lincoln Generating Station.

Candidates should have a wide experience in the operation, maintenance and administration of an electricity generating station, and the possession of technical qualifications admitting to Corporate Membership of a recognised professional institution will be an advantage.

Salary will be in accordance with Class E, Grade 1 (£1,035 x £30—£1,125 per annum) of the National Joint Board Agreement.

Closing date for receipt of applications: 7 June, 1955.

These appointments will be pensionable within the terms and provisions of the Central Electricity Authority and Area Boards Superannuation Scheme.

Applications should be submitted on the

continued in next column

continued from previous column

official form A.E.6/ACT which may be obtained from the Divisional Establishments Officer, Central Electricity Authority, P.O. Box 25, Barker Gate, Nottingham, and should be returned to the undersigned by the date stated. Please quote Vacancy Number.

L. F. JEFFREY,
Divisional Controller.
13 May, 1955. (R 842)

## CENTRAL ELECTRICITY AUTHORITY
### South Western Division

1ST ASSISTANT STATION CHEMIST required at Portishead "A" Power Station. Superannuation Scheme. N.J.B. Class J, Grade 9, £790/£850.

Applicants should possess as a minimum chemistry qualification the Higher National Certificate. A thorough appreciation of the objects of chemical servicing and experience of modern analytical techniques essential. Power Station laboratory experience considered an advantage. Successful candidate will be responsible to the Station Chemist for the day to day work of the laboratory.

Chemical services for both Portishead "A" and "B" Power Stations proposed when the new station commissioned. Ultimate combined N.J.B. Classification, Class L.

Applications on Form AE6/ACT obtainable from the Divisional Secretary, 26 Oakfield Rd, Bristol 8, should be completed and returned by 31 May, 1955. (R 818)

## CITY OF MANCHESTER
### City Architect's Office

APPLICATIONS are invited for the undermentioned appointment on the permanent staff:

SENIOR ELECTRICAL ENGINEER. Salary Grade APT IV, £675/£825 per annum. Applicants must be Associate Members of the Institution of Electrical Engineers and be experienced in the preparation of schemes for electrical, light and power installation in all classes of buildings.

Further particulars and forms of application may be obtained from the City Architect, Box No. 488, Town Hall, Manchester 2. The completed form to be returned to the same address by 7 June, 1955. Canvassing is prohibited. (R 791)

## CENTRAL ELECTRICITY AUTHORITY
### South Wales Division

Vacancy No. 54/55

APPLICATIONS are invited for superannuable N.J.B. appointment of ASSISTANT SHIFT CHARGE ENGINEER at Carmarthen Bay Power Station near Burry Port.

Salary: K.9—£840 x £20 to £900 per annum.

H.N.C. and regular apprenticeship desirable.

Experience in a modern generating station essential.

Application forms obtainable from Secretary, South Wales Division, Central Electricity Authority, Twyn-y-Fedwen Rd, Gabalfa, Cardiff, to be returned by 9 June, 1955. (R 868)

AN electrical engineering DESIGNER DRAUGHTSMAN is required for a large and expanding factory in North Staffs. Minimum qualification O.N.C. (electrical) but H.N.C. preferred. The work calls for a high degree of initiative and includes Factory distribution and cabling; motor applications; control gear engineering; lighting schemes, substation work; power factor correction, etc. Assistance with housing given if necessary. Write in confidence stating age, qualifications, experience and present salary to the Personnel Manager, Michelin Tyre Co., Ltd., Stoke-on-Trent. (R 661)

AN ASSISTANT with experience of Trade Counter required, for Wholesale Department of progressive Firm in South Midlands. Commencing salary in accordance with ability and knowledge, but £10 10s. minimum. Sound prospects. Apply—Box No. 4533, Electrical Times. (R 804)

**COMMERCIAL ENGINEERS**

English Electric at Stafford have vacancies in the following Contracts Sections for both Senior and Junior Engineers, who possess the H.N.C. (Electrical).

Candidates should have served an apprenticeship in manufacturing industry or have operating experience of heavy electrical plant. For the Junior positions previous commercial experience although desirable, is not essential.

(1) Metal Industries Division, dealing with complete schemes for all types of Rolling Mills.

(2) Electrical Plant Department, engaged mainly on the application of Rotating Electrical Machines of all sizes.

(3) Switchgear Department, concerned mainly with the application of H.V. Switchgear.

Good opportunities exist for advancement, depending upon individual ability.

Please reply to Dept. C.P.S. 336/7 Strand, W.C.2, quoting Ref: SA9J.

(R 794p)

APPLICATIONS are invited from INDUSTRIAL HEATING ENGINEERS who wish to join the Sales Organisation of The General Electric Co., Ltd., in London and the Provinces to promote sales in space heating and other I.H. equipment. Candidates, not over 35 years of age, should have the H.N.C. in electrical engineering and previous sales experience. These positions offer excellent prospects to those having a good personality and initiative. Apply in writing, quoting Ref.: I.H. to the Staff Manager, Magnet House, Kingsway, London, W.C.2. (R 797)

AN EXPERIENCED D.C. DESIGNER capable of using his initiative required for interesting work on dynamo electric machines from 5 to 5,000 h.p./kW. A superannuation scheme in operation and the usual social amenities available in an organisation of progressive outlook. All applications will be treated with the strictest confidence and should be addressed to the General Manager, Lancashire Dynamo and Crypto Ltd., Trafford Park, Manchester 17. (R 855)

APPLICATIONS are invited by The General Electric Co., Ltd., from qualified ELECTRICAL ENGINEERS with contractor training who are interested in joining their Sales Organisation in London. Applicants should not be over 30 years of age, and have had experience in the design of installations. This is an interesting position and offers good opportunities for advancement. Apply in writing, quoting Ref.: B.D. to The Staff Manager, Magnet House, Kingsway, London, W.C.2. (R 861)

ASSISTANT CORROSION ENGINEER required by Kuwait Oil Company for service in Kuwait. Applicants must hold a degree in electrical or chemical engineering or chemistry or physics preferably with some knowledge of metallurgy. In addition must have had at least 2 years' industrial experience. Work will be on corrosion mitigation problems which include scope for development of anti-corrosion techniques, installation and maintenance of protection stations and will be largely of a practical nature. Age 24-27. Salary starting not less than £830 per annum clear, plus generous allowances. Pension Scheme and kit allowance. Write for application form, giving brief details and quoting K.1859 to Box E/36, c/o 191 Gresham House, E.C.2. (R 862)

BRUSH Electrical Engineering Co., Ltd., Loughborough, Leics, is seeking a CHARTERED ELECTRICAL ENGINEER for appointment to their agents in Rangoon. This is a senior appointment and applicants should be capable of advising customers at the highest level on the application of the Companies products, which include Switchgear, Transformers and Rotating A.C. and D.C. machines. Candidates should just have served a recognised apprenticeship with a reputable electrical engineering concern followed by experience of tendering procedure and handling of large contracts. Previous sales experience would be an advantage. Applications should be addressed to the Chief Personnel Officer. (R 744)

CANADA: Enfield Cables Limited wish to appoint SENIOR EXECUTIVE to control their Selling Organisation in Canada. Should have had considerable selling experience overseas and be familiar with problems associated with High Voltage transmission and with the supply and lay of E.H.V. Cables. Applications to be addressed to Sales Director, Enfield Cables Ltd., Victoria House, Southampton Row, London, W.C.1. (R 873)

CENTRAL ELECTRICITY AUTHORITY, North Eastern Division, require a CHIEF ASSISTANT ENGINEER (Mechanical) in the Generation (Construction) Department, at Divisional Headquarters, Newcastle upon Tyne. Candidates should have received a first class technical education and should preferably hold a recognised mechanical engineering degree or be a Corporate Member of one of the Professional Institutions. They should also have a wide practical knowledge of the design, layout, construction, and operation of generating stations.

Provisional salary N.J.M. Scale 2, £1,400/£1,550 per annum.

Applications stating age, present position and salary, and giving full details of qualifications and experience to D. Moffat, Director of Establishments, Winsley St, London, W.1, by 31 May, 1955. Quote Ref. ET/598. (R 860)

CHIEF TRANSFORMER TEST ENGINEER, required to take full responsibility for Test and Inspection Dept. Salary commensurate with qualifications and experience. Apply in confidence to the Managing Director, Transformers (Watford) Limited, Sandown Rd, Watford, Herts. (R 799)

CHIEF BUYER required by an Electric Cable Company in the North-West. Previous experience or knowledge of the industry preferable. This is a senior and responsible position and carries a good commencing salary with excellent prospects of advancement, therefore, only men of first class character and ability need apply. The Company's own staff have been notified of the above. Apply giving age and full details of experience to—Box No. 4531, (R 803)

CONDUIT/WIRING ESTIMATOR for specifying quantities. Practical experience and knowledge wiring diagrams essential. Office experience advantage. Staff appointment. Pensionable. Apply Waygood-Otis Ltd., Falmouth Rd (HOP. 3121). (R 858)

**ELECTRICAL RESEARCH ASSOCIATION**

TECHNICAL ASSISTANTS required at the Shinfield Field Station for research and development work on Applications of Electricity in Agriculture and Horticulture.

Starting salary will be in the range £550 to £750 p.a. (with superannuation provisions) according to qualifications and experience.

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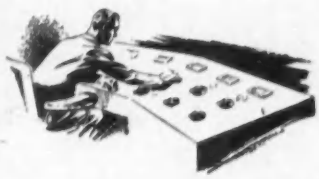

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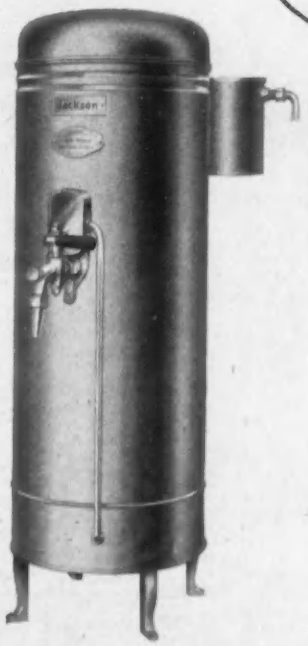


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This is the DORMAN 'TS' FUSED SWITCH—a modern compact unit which provides positive action with perfect safety: designed to suit a variety of installations and constructed of first quality materials. The quick double break action mechanism withstands Admiralty shock tests and the removable fuse carriage will take HRC or rewireable fuses, or copper strips. For 500 V and up to 300 A. SP. DP. TP. TPN.

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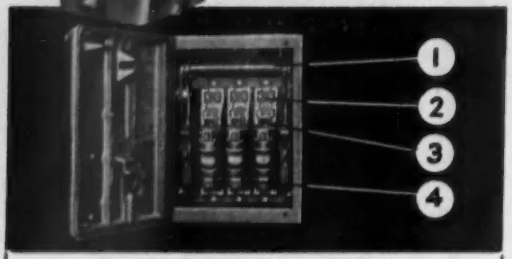


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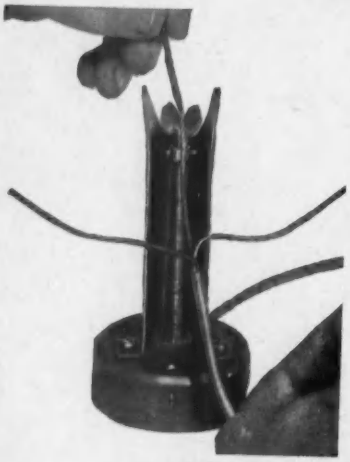

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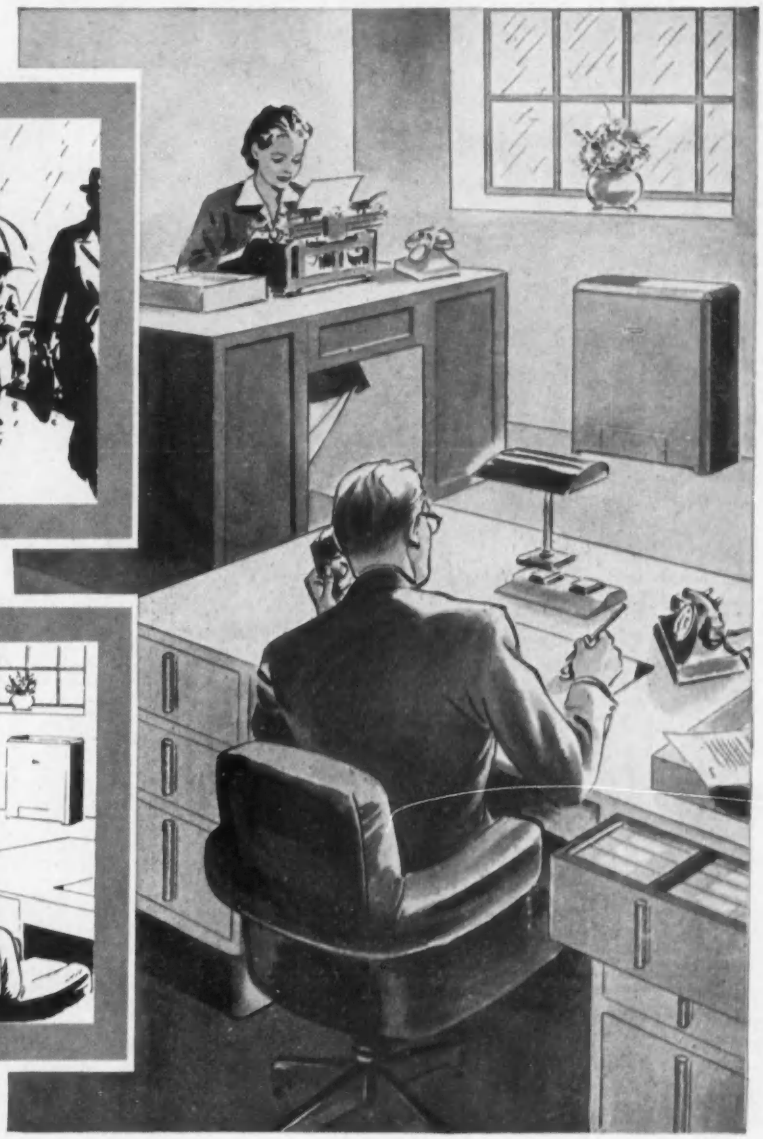

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The Nightstor Heater is available in three sizes. Write for descriptive leaflet H02482.

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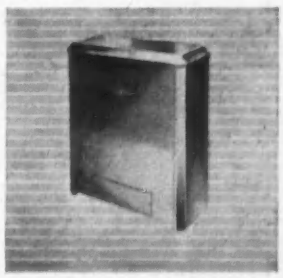

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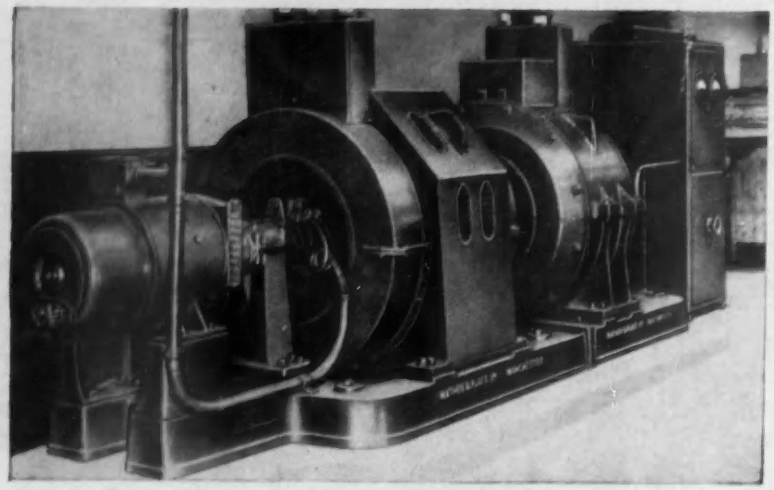

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## MOTOR GENERATOR SETS

The motor generator set illustrated is installed at a South of England paper mill. The motor is a direct-on started 435 h.p. synchronous machine, 400 v., 0·5 leading power factor, 1,000 r.p.m., starting current 2½ times full load current. The D.C. generator supplies 300 kW, at 230 v.

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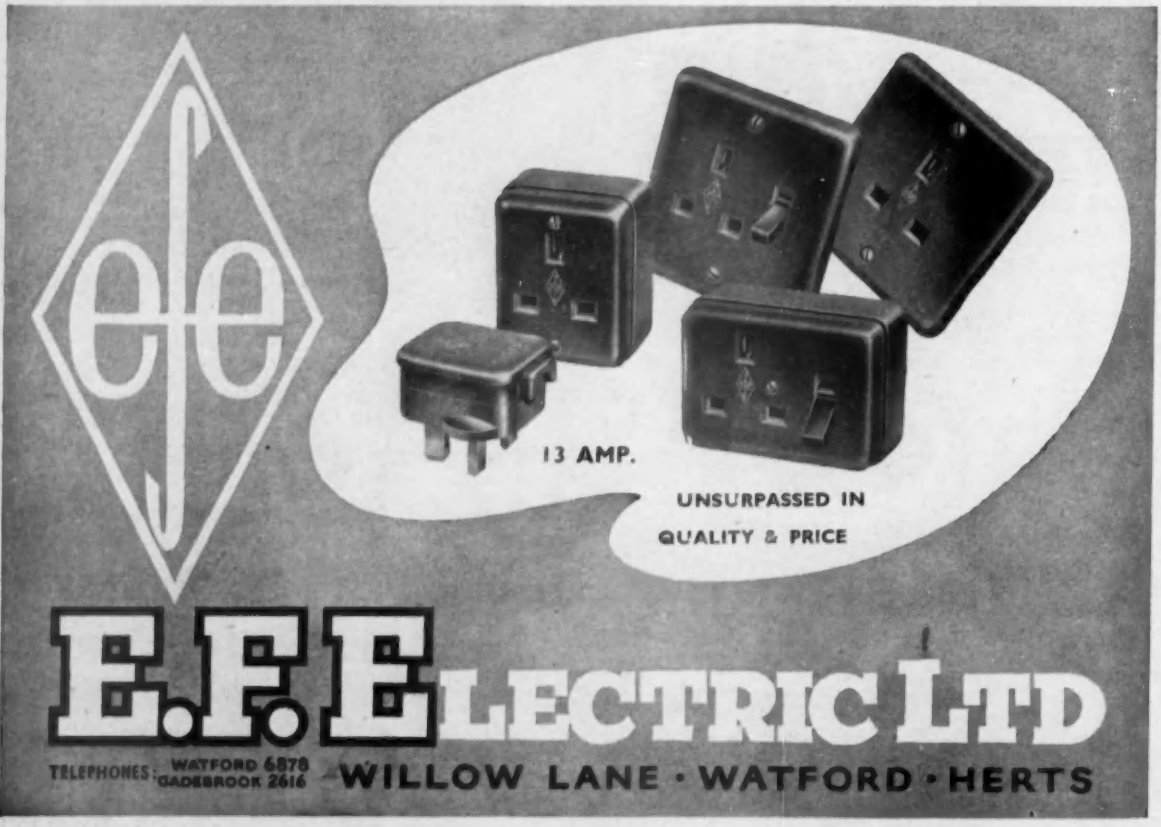

CONTACTOR SWITCHGEAR LTD
WOLVERHAMPTON
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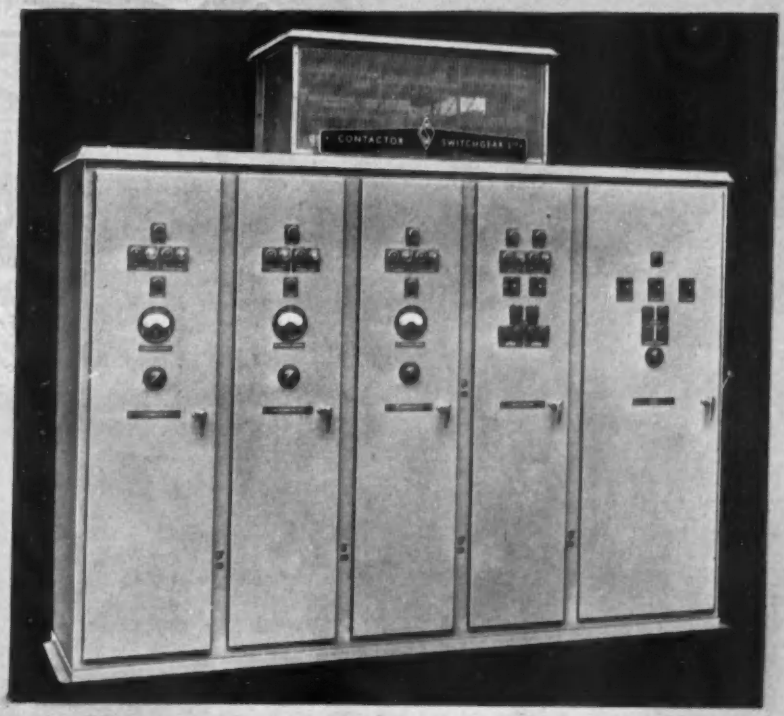
# Automatic Motor Control Gear



## For Heating and Ventilating Plant

The Company's activities cover the supply of automatic control gear to many varied applications throughout industry. These activities are typified by the accompanying illustration of a multi-motor panel supplied for an air conditioning plant.

Features of this equipment include automatic star/delta and stator/rotor starting of refrigeration compressor motors, condenser fans, and chilled water pumps with provision for selection of duty and standby machines, sequence starting with pre-selection of sequence, and choice of hand/automatic control. Pilot lamps indicate motors running or overload fault.

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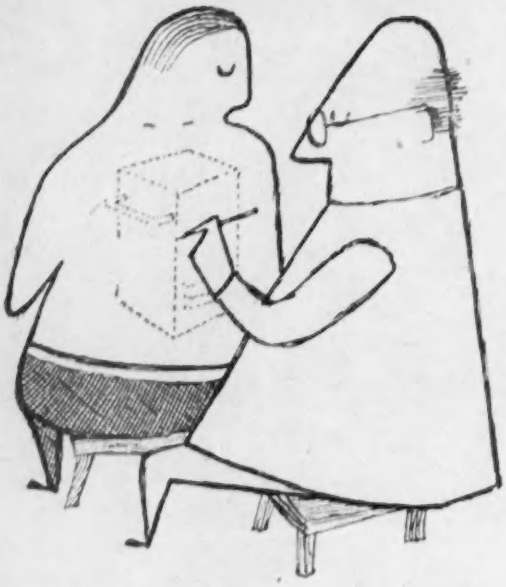

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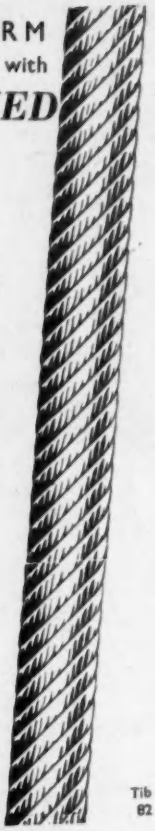

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**This contract is typical of the many which London Electric Firm handle during the course of their business. They have the experience and "know-how" so essential for this specialised job.**

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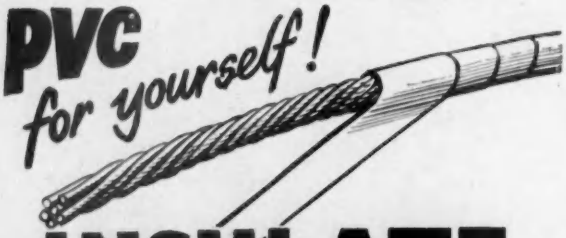

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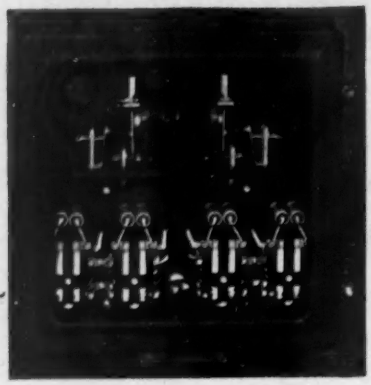

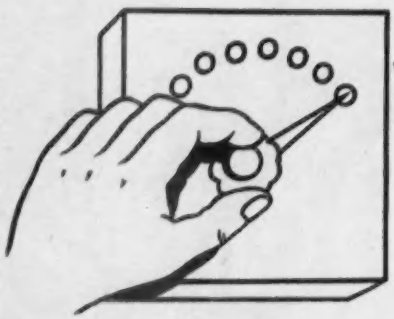

As specialists in the field we shall be pleased to advise on the question of automatic voltage regulation if we may receive particulars of your specific requirements for any loading.

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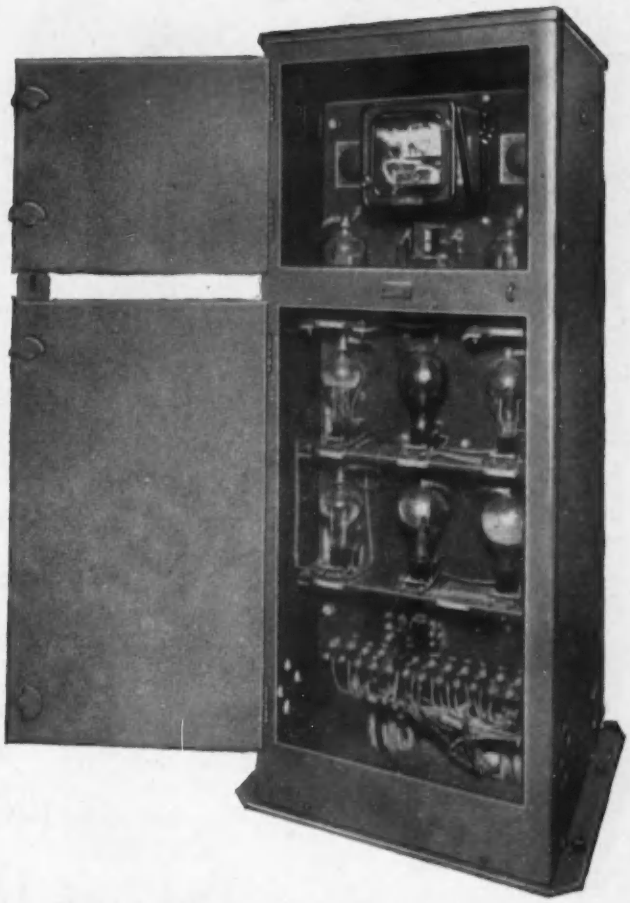

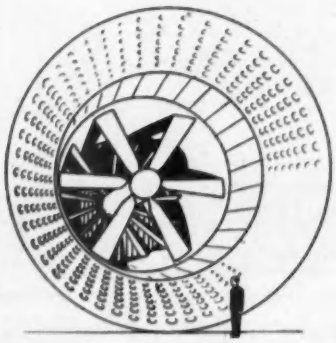

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is accurately controlled by the equipment illustrated here. Installed at the Royal Aircraft Establishment, Farnborough, in 1934, it has been in continuous service ever since. The equipment controls a 2,000 H.P. wind-tunnel fan-motor by means of a motor-operated rheostat in the field system of a Ward-Leonard set, the rheostat being controlled by relays energised by Thyratrons. Two independent control stations are provided, one on the floor of the Test House and the second high up near the roof of the tunnel. Hand or auto-control can be obtained from both positions.

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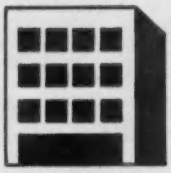

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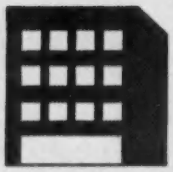

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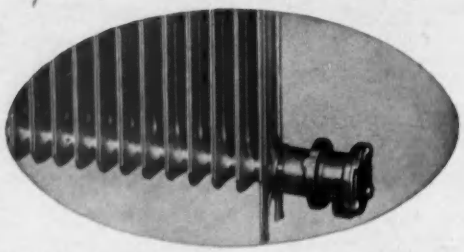

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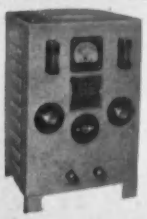

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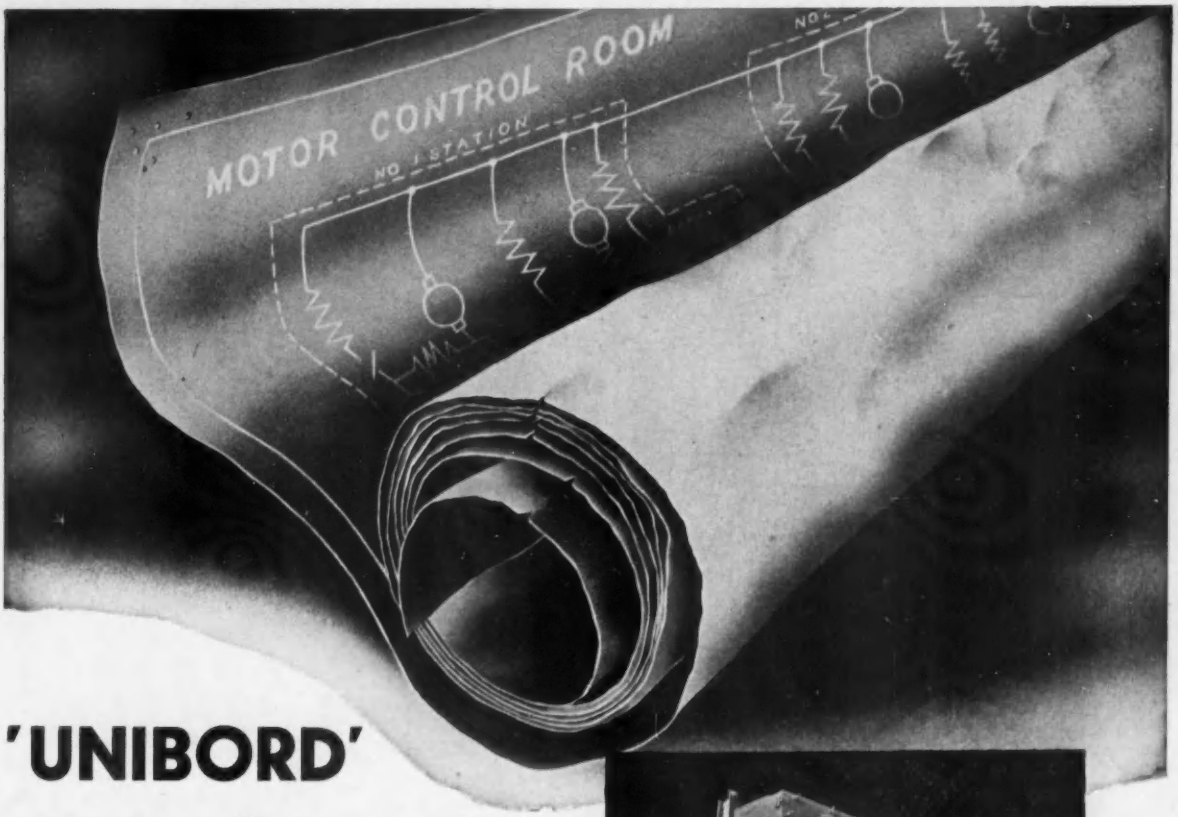


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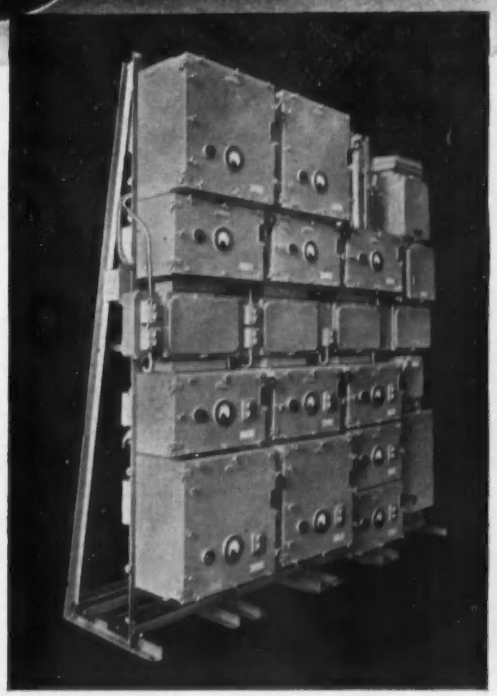
## *construction saves time and money*

The adjacent illustration will convey much to the discerning engineer. It shows the space-saving compactness of 'Unibord' construction and how readily erection, re-siting and extension can be carried out. What the illustration does not show is the in-built dependability of every unit in the Brookhirst standard range—the result of more than 40 years' experience in the design of high quality motor control gear.

*Further details of 'Unibord' Motor Control Equipment are contained in Publication* 631A. *May we send you a copy?*



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*A METAL INDUSTRIES* M *GROUP COMPANY*

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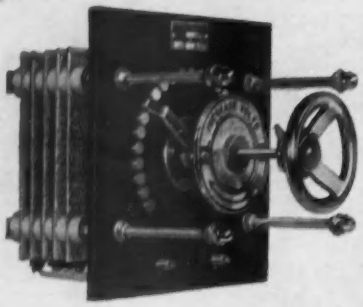

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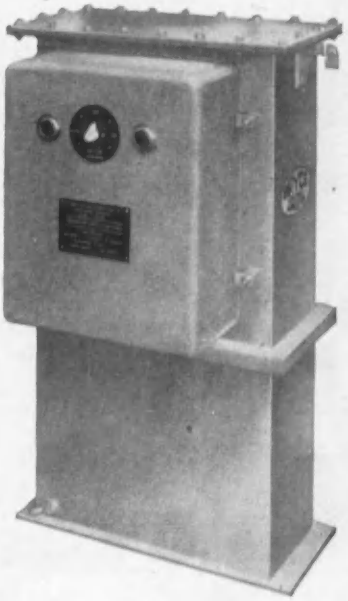
2. They occupy minimum floor space.
3. They can be supplied with individual contactor panels as illustrated.
4. Unit type capacitors can be supplied for individual motor correction.



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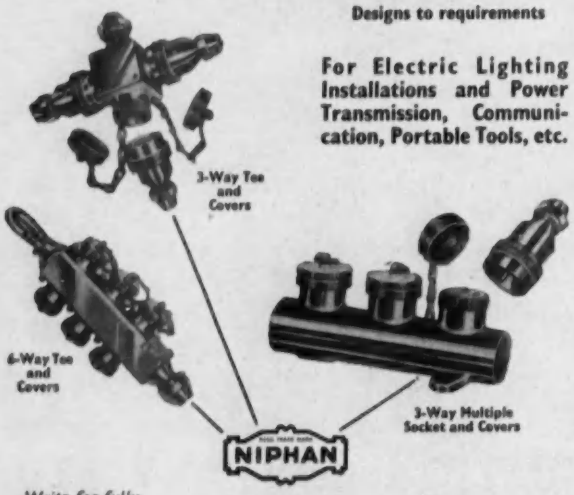


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